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## **V**oluntary Contributions to a Public Good with Intrinsic Motivation in a Large Economy

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**Abstract**

This paper develops a theoretical model of voluntary contributions to a public good in a large economy where the impact of each individual's contribution on the total provision is negligible, and people's preference consists of extrinsic and intrinsic payoffs. Of particular interest is moral motivation that is assumed to be formulated internally and independently of other people in the intrinsic payoff. Adopting an equilibrium concept, we discuss public provision that could affect moral motivation. With this approach, we demonstrate that a wide variety of crowd-out/in hypotheses can occur within a single framework, once the interplay between extrinsic and intrinsic payoffs is introduced. The model provides the conditions under which public provision induces crowd-out as well as crowd-in. It is shown that the effect of public provision highly depends on the degree of motivational shift originating from the intrinsic payoff as well as the characteristics of the public good in relation to the private good in the extrinsic payoff.

**Key Words:** voluntary contribution, intrinsic and extrinsic motivations, large economy

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\* We are responsible for any remaining errors.

# 1 Introduction

This paper develops a theoretical model of voluntary contributions to a public good in a large economy where the impact of an individual's contribution on the total provision is negligible. Standard theory of a pure altruism model suggests that rational agents give no contribution in a large economy (Andreoni (1988)). However, empirical evidence shows that a substantial portion of people make significant contributions even in such an environment (see, e.g., Rondeau et al. (2005), Frey and Meier (2004), and Poe et al. (2002)).<sup>1</sup> Faced with this evidence, the following question naturally arises: “what motivates voluntary contributions to a public good in a large economy?”

Several responses to this question have been put forward in a series of papers. They claim that human behaviors are determined by the trade-off between extrinsic and intrinsic motivations, and deviations from economic theory in voluntary contributions may be due to the existence of such decision mechanisms (see, e.g., Frey and Oberholzer-Gee (1997), Schram (2000), Benabou and Tirole (2003), and Le-Grand (2003)). The extrinsic motivation represents self-interest preferences that lead to the typical law of demand in economics, while the intrinsic motivation represents non-material component in preferences.

The intrinsic motivation has been acknowledged as crucial in discussing voluntary contributions and could be mainly divided into the following two types based on past literature: the first type is ‘moral motivation’ that is based on personal satisfaction from doing some duty or public service; and the second is ‘social motivation’ which may be evolved through social interactions with others such as fairness concern or reputation building.<sup>2</sup> Although the building blocks for the analysis introduced in this paper could be easily extended to the case of social motivation, this paper focuses upon modeling moral motivation that characterizes intrinsic payoffs as a benchmark analysis.

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<sup>1</sup>These studies are implemented in an environment adapted to mimic field conditions of voluntary contribution in a large economy. First, people only knew that they belong to a large group, but they were not informed of the exact number of participants. Second, the anonymous treatment is employed so that the motivation of social approval or interaction with others is controlled.

<sup>2</sup>There are several previous papers in which social motivation is modeled in public goods setting (See, e.g., Hollander (1990), Lindbeck (1997), Cowen (2002), Brennan and Brooks (2007) and Rege (2004)).

Andreoni (1990), Andreoni (1989) and Brekke et al. (2003) build theoretical models with moral motivation as intrinsic payoffs for voluntary contributions. Similar to these models, our focus is on modeling the decision to make voluntary contributions. However, there are some distinctions between this and previous models. Past models are based on a Nash solution with a finite number of people, where the impact of individual contributions on the total provision is not negligible. On the contrary, we extend the model to the large economy setting, where the impact of individual contributions is negligible. Instead of a game-theoretic approach, we use an equilibrium concept in the sense that the private provision of a public good that each person conjectures ex-ante is consistent with the private provision that is the sum of individual contributions ex-post.

Utilizing the equilibrium concept of voluntary contributions in a large economy, this paper studies the effect of public provision on the private provision of a public good. Economists have long sought to develop a theoretical model of voluntary contributions for this type of the analysis. Warr (1982) and Roberts (1984) show that government grants crowd out voluntary contributions dollar for dollar in a pure altruism model. The impure altruism model, developed by Andreoni (1990), predicts that government grants incompletely crowd out voluntary contributions. Ribar and Wilhelm (2002), applying the impure altruism model, further analyze the degree of crowd-out when the number of people asymptotically goes to infinity. They show that zero crowd-out may prevail even under the weak assumption of homogeneous preferences among agents. In summary, each previous model yields a unique and single prediction, which is in contrast with some real world evidence (Nyborg and Rege (2003)). The empirical studies such as Straub (2004), Payne (1998), Ribar and Wilhelm (2002), and Okten and Weisbrod (2000) show incomplete crowd-out and/or zero crowd-out. Furthermore, Khanna and Sandler (2000) show evidence of crowd-in.

In contrast to previous theoretical models analyzing crowd-out hypotheses, our model newly considers the effect of a ‘motivational shift’ that comes from intrinsic payoff in a utility function. The motivational shift is regarded as a change in intrinsic motivation caused by

government intervention. This concept has been introduced in social psychology and has been applied in the economics literature as well (see, e.g., Frey and Oberholzer-Gee (1997) and Le-Grand (2003)). They argue that government intervention can affect voluntary activities through which people express their intrinsic motivations. While it is clear that people may experience such motivational shift, to the best of our knowledge, no tractable model of this effect on voluntary contributions has been explored.

With this new approach, the model suggests that a wide variety of crowd-out/in hypotheses can occur within a single framework, which may be consistent with empirical evidences. Our model yields the conditions for complete or incomplete crowd-out as well as crowd-in, and we give economic intuitions and interpretations to these results and their differences. The new insight is that once the interaction between extrinsic and intrinsic payoffs induced by government intervention is considered, unconventional and novel consequences on total provision of public goods could be realized. More precisely, the effect of government intervention on the total provision depends on the degree of motivational shift originating from the intrinsic payoff as well as the characteristics of the public good in relation to the private good in the extrinsic payoff.

To the best of our knowledge, this would be the first research that successfully provides crowd-out as well as “crowd-in,” and shows their corresponding conditions within a single model. Our results not only contribute to the theoretical aspects on understanding voluntary contributions but also adds some policy implications to the real world problems. As noted in Nyborg and Rege (2003), numerous examples of voluntary contributions can be found in the context of environmental problems. To solve environmental problems such as global warming, it is desirable that central authorities take an initiative for providing a global public good and enhance more cooperation with private agents, which is exactly corresponding to the situation of crowd-in. While our intuitions tells us that crowding-out will prevail when the government provides a public good, our results can clearly suggests one possibility or condition that crowd-in will occur when the interplay between extrinsic and intrinsic payoff

is considered. If this is the case, our results of crowd-in could be considered an exceptional and interesting case that the government should take a strong role to solve the problems associated with voluntary contributions.

The remainder of this paper consists of three sections. In the next section we outline the model of voluntary contributions in the large economy. That section is followed by a formulation of the equilibrium concept and an analysis of the impact of government policy on total provision of a public good. We present several propositions and elaborate on the economic intuition based on the findings. In the final section, we offer some conclusions.

## 2 The Model

We consider an economy with only one private good and one public good, where the private good can be converted into the public good by a linear technology so that each can be expressed in units of dollars. There are a large number of homogeneous people, whose mass is normalized at unity.<sup>3</sup> Each individual is endowed with identical wealth  $w > 0$  so that she can allocate between consumption of the private good and contributions to the public good. The utility function of each individual is assumed to be given by:

$$u = v(x, G) + L, \tag{1}$$

where  $x \geq 0$  is the consumption of private goods,  $G \geq 0$  is a pure public good, and  $v$  is increasing and strictly concave. The first part,  $v(x, G)$ , referred to as an extrinsic payoff, represents a standard benefit from consumption of a private good and total public good provided. The second part,  $L$ , referred to as an intrinsic payoff, represents the utility from non-material compartment in preference. This specification is an extension of the one used by Frey and Oberholzer-Gee (1997) in the context of voluntary contributions and captures a situation where the decision is made by the relationship between the extrinsic and intrinsic

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<sup>3</sup>Although our model can be built under the assumption of heterogeneous agents as well, the qualitative results are not significantly affected.

payoffs.

The value of the cross derivative of the extrinsic payoff,  $v_{xG}$ , defines the complementarity or the substitutability between the private good and the public good. Formally, a private good  $x$  and a public good  $G$  are defined as extrinsic complements if  $v_{xG}(x, G) > 0$  for all  $x$  and  $G$ , while they are defined as extrinsic substitutes if  $v_{xG}(x, G) < 0$  for all  $x$  and  $G$ . In addition, they are extrinsic independent if  $v_{xG}(x, G) = 0$  for all  $x$  and  $G$ .<sup>4</sup> The condition  $v_{xG} > 0$  ( $v_{xG} < 0$ ) implies that the marginal benefit of the private good is increasing (decreasing) in the public good, or the marginal benefit of the public good is increasing (decreasing) in the private good. Thus, a public good with the extrinsic complementarity (substitutability) becomes more (less) attractive as the consumption of a private good increases. The absolute value of  $v_{xG}$  represents the degree of the extrinsic complementability if positive, and it represents the degree of the extrinsic substitutability if negative. As discussed in a later part, this feature is a key component in determining the total provision of the public good.

We next introduce the formulation of the intrinsic payoff,  $L$ . This sub-payoff comes from moral motivation which is based on personal satisfaction from doing some duty or public service. Such motivation is modeled by Andreoni (1989), Andreoni (1990), and Brekke et al. (2003). Similar to the approach of moral motivation in Brekke et al. (2003), the intrinsic payoff is determined by the relationship between the actual contribution,  $g$ , and the intrinsically ideal contribution,  $h$ . Elster (1989) calls this type of decision process “everyday Kantian” (see page 192) and argues that people first try to identify their duty (intrinsically ideal contribution) in a collective decision, and next their actual decisions are determined by considering the trade-off between the cost and the benefit of the duty.

In this paper, the intrinsically ideal contribution refers to the contribution level each individual internally thinks “I should ideally contribute as a member of the society.” With regard to the intrinsic payoff, the best one can do is to provide the intrinsically ideal contri-

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<sup>4</sup>The extrinsic substitutability and extrinsic complementarity between  $x$  and  $G$  are not exclusive. The condition of  $v_{xG}(x, G) > 0 (< 0)$  must hold for all  $x$  and  $G$ , i.e., not only pointwise but also globally. Notice that our notion of the complementarity and the substitutability could be different from the conventional definitions in standard microeconomics textbooks.

bution. To capture this ingredient, we assume that the intrinsic payoff for each individual is given by:

$$L \equiv f(g, h), \tag{2}$$

where  $f_g > 0$  for any  $g < h$  and  $f_g < 0$  for any  $g > h$ , and  $f_{gg} < 0$  so that the intrinsic payoff is strictly concave and attains its maximum at  $g = h$ . This specification requires that each individual intrinsically receives a payoff loss if she contributes an amount different from the intrinsically ideal level. The payoff loss becomes larger as the actual contribution deviates from the intrinsically ideal level. We also assume  $\lim_{g \rightarrow 0} f_g(g, h) = \infty$  for any  $h$  so that each individual will provide a positive contribution to the public good.

The crucial assumption is that the marginal benefit of the individual contribution is increasing in the intrinsically ideal contribution, i.e.,  $f_{gh} > 0$ . This captures a situation in which a rise (decline) in the intrinsically ideal contribution  $h$  encourages (discourages) people to contribute to the public good through raising (reducing) the marginal benefit of the individual contribution. We call this change in intrinsic payoff the *motivational shift* associated with a change in the intrinsically ideal contribution. A larger value of  $f_{gh}$  implies a higher level of the motivational shift and gives greater individual encouragement for contribution. More specifically, an increase in the marginal benefit caused by a rise in  $h$  is called *motivation-in*. Conversely, a decline in the marginal benefit caused by a decline in  $h$  is called *motivation-out*. The motivational shift is a key element, as well as the complementarity or the substitutability between the public and private goods defined by the sign of  $v_{xG}$ . By equations (1) and (2), the utility function for each individual can be rewritten by:

$$u(x, g : G, h) = v(x, G) + f(g, h). \tag{3}$$

This study assumes that a mass of individuals is employed to conceptualize an economy in which an individual contribution is too small to affect total public good provided, i.e.,  $G$  is

completely external to all individuals when individuals make a decision in a large economy. Hence, the classic free-riding behavior is out of the scope in this study. This assumption may be a convenient simplification, in contrast to the conventional studies in which the Nash solution is applied under the assumption that there are a finite number of agents and the effect of an individual contribution on total provision is not negligible.

To study the impact of a change in public provision in our framework with the extrinsic and intrinsic motivations, we assume that the government has complete information about individuals' preference and can implement public provision  $D \geq 0$ , keeping balanced budget by imposing equally on each individual a lump-sum taxation.<sup>5</sup> Since the mass of individuals (population) is normalized at unity and all individuals share the same preference, the disposable income for each individual is given by  $\bar{w} \equiv w - D$ , and total provision of the public good is equal to public provision  $D$  and private provision  $g$ :

$$G = g + D. \tag{4}$$

Government intervention can alter intrinsic motivation for individual contribution. The expression of the intrinsically ideal contribution should account for motivational shift, as studied in Frey and Oberholzer-Gee (1997) and Le-Grand (2003). To capture this, we assume that the intrinsically ideal contribution  $h$  is negatively affected by public provision of the public good,  $D$ , and it is given by:

$$h \equiv h(D), \tag{5}$$

with  $h'(D) < 0$  and  $\lim_{D \rightarrow \infty} h(D) \geq 0$ . The intrinsically ideal contribution is formulated individually and independently of other people's behaviors, and it depends only on public

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<sup>5</sup>This balanced budget assumption is also employed in Andreoni (1989) and Andreoni (1990). He assumes that the government has two policy tools: (i) subsidy to the individual contribution and (ii) the lump sum tax. Accordingly, the net tax receipts are directed to public provision and it is subject to the balanced budget. In contrast, our model analyzes the effect of public provision as a government policy on private provision, and the lump sum tax is subject to the balanced budget. We do this since our focus is on the effect of motivational shift on private provision through the change in public provision.

provision.<sup>6</sup> Notice that an increase in  $D$  decreases the value of  $f_{gh}(g, h(D))$  due to the assumption of  $f_{gh}(g, h) > 0$ . Thus, an increase in public provision induces motivation-out through a decline in the intrinsically ideal contribution, while a decrease in public provision induces motivation-in through a rise in the intrinsically ideal contribution.

### 3 Analysis

This section first examines rational behavior of each individual taking the intrinsically ideal contribution  $h$  as given. Then, we characterize the equilibrium outcome and discuss crowd-in/out hypotheses through analyzing the impact of public provision.

#### 3.1 Individual Behavior

This subsection characterizes the behavior of an individual, taking disposable income,  $w - D$ , the intrinsically ideal contribution,  $h$ , and the ex-ante total private provision of the public good,  $P$ , as given. We refer to total private provision as ‘ex-ante’ at this point since in a later section we introduce the equilibrium concept, where total private provision is endogenously determined ex-post. The value of  $P$  could be regarded as an individual’s conjecture of total private provision, and such a conjecture is assumed to be identical for all individuals. Each individual maximizes the utility (3) with respect to  $g \geq 0$ , subject to her budget constraint  $x + g = w - D$  with the conjecture of  $P$ . The following first-order condition characterizes an optimum:<sup>7</sup>

$$v_x(w - D - g, P + D) = f_g(g, h). \quad (6)$$

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<sup>6</sup>One possible simplification of the function  $h$  may be  $h(D) = G^\circ - D$ , where  $G^\circ$  represents a socially optimal level of a public good  $G^\circ$ , which is determined by the social welfare maximization problem:  $G^\circ \equiv G^\circ(w) = \arg \max_{G \geq 0} v(w - G, G)$ . In this case, it should be assumed that  $G^\circ$  is common knowledge in a society. Whether or not an intrinsic payoff should be included in social welfare is discussed by Andreoni (2004). He mentions that counting “warm glow” in welfare is problematic and misleading. This implies that we should ignore the intrinsic payoff in social welfare maximization.

<sup>7</sup>We assume that there exists an interior solution to the individual problem.

This condition requires that, for any individual, the marginal benefit of a private good consumption (the marginal cost of individual contribution) in the extrinsic payoff equals the marginal benefit of individual contribution in the intrinsic payoff. Exploiting the assumed properties of the utility function, the condition (6) yields the ex-ante individual contribution,  $g^* \equiv g^*(P, h, D)$ , which represents the amount of contribution made by an individual confronted with  $P$ ,  $h$  and  $D$ .

Regarding the comparative statics of the ex-ante individual contribution  $g^*$ , differentiating equation (6) with respect to  $h$ ,  $D$  and  $P$  yields:

$$g_h^* = -\frac{f_{gh}}{\Delta}; \quad g_D^* = \frac{v_{xG} - v_{xx}}{\Delta}; \quad g_P^* = \frac{v_{xG}}{\Delta}, \quad (7)$$

where  $\Delta = f_{gg} + v_{xx} < 0$ . The values of  $g_h^*$ ,  $g_D^*$  and  $g_P^*$  represent the change in the ex-ante private provision in response to a change in the intrinsically ideal contribution, public provision, and the ex-ante total private provision, respectively. Since the denominator of the expressions in (7) is negative, the direction of the comparative statics is determined by the sign of the numerator, which is related to either the extrinsic payoff  $v(x, G)$  or the intrinsic payoff  $f(g, h)$ . By  $f_{gh} > 0$  and  $v_{xx} < 0$ , our model specification implies that (1)  $g^*$  is increasing in  $h$ ; (2)  $g^*$  is increasing in  $P$  if  $v_{xG} < 0$  and is decreasing in  $P$  if  $v_{xG} > 0$ ; and (3)  $g^*$  is increasing in  $D$  if  $v_{xG} < v_{xx}$  and is decreasing in  $D$  if  $v_{xG} > v_{xx}$ .

First, the sign of  $g_h^*$  depends on the intrinsic payoff.  $g^*$  is increasing in  $h$  since an increase in  $h$  causes motivation-in. Second, the sign of  $g_P^*$  depends on that of  $v_{xG}$  in the extrinsic payoff. Suppose that  $x$  and  $G$  are extrinsic complements (substitutes), i.e.,  $v_{xG} > 0$  ( $v_{xG} < 0$ ). In this case, the marginal benefit of the private good is increasing (decreasing) in the ex-ante total provision,  $G$ , i.e., the individual contribution becomes less (more) attractive as  $G$  increases. Thus,  $g^*$  is decreasing (increasing) in  $P$ . Third, the sign of  $g_D^*$  also depends on the extrinsic payoff. An increase in  $D$  affects  $g^*$  through two channels: the first comes from the increase in total provision; and the second comes from the reduction in disposable income. The first impact depends on the extrinsic complements or substitutes of the two goods. If

the two goods are extrinsically complements, an increase in  $D$  reduces  $g^*$ . In contrast, if the two goods are extrinsically substitutes, the impact of a change in  $D$  is ambiguous on  $g^*$ . In a later part, the values of  $g_h^*$ ,  $g_D^*$  and  $g_P^*$  play a crucial role in characterizing total private provision in an equilibrium.

### 3.2 Equilibrium

The previous subsection has examined the problem for individuals confronted with  $h$ ,  $D$ , and  $P$ . In this subsection, we explore an equilibrium outcome in the whole society, taking public provision of the public good,  $D$ , as given. In particular, total private provision is determined endogenously in the model.

We now introduce the concept of an equilibrium (fulfilled expectations equilibrium), where all people correctly foresee total private provision of the public good. In an equilibrium, the conjecture of total private provision people make prior to their individual contribution decision must be equal to the resulting total private provision.<sup>8</sup> Let  $\hat{P} \equiv \hat{P}(D)$  denote the equilibrium level of total private provision of the public good with public provision  $D$  as given. An equilibrium is characterized by the condition that the ex-post total private provision is consistent with the ex-ante total private provision derived from individuals' decision problem based on the ex-ante or conjectural total private provision, or i.e.,

$$\hat{P} = g^*(\hat{P}, h(D), D). \tag{8}$$

The following result arises from an inspection of the uniqueness of an equilibrium:

**Proposition 1 (Uniqueness of Equilibrium)**

*Suppose  $g_P^*(P, h(D), D) < 1$  for all  $P > 0$ . Then, there exists a unique (stable) equilibrium level of total private provision of the public good  $\hat{P} \equiv \hat{P}(D) > 0$ .*

Recall that the value of  $g_P^*$  measures the effect of a rise in the ex-ante total private provision

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<sup>8</sup>This equilibrium concept is also similar to the one introduced in Hollander (1990).

$P$  on the ex-ante individual's private provision  $g^*$ . The sign of  $g_P^*$  is determined by the extrinsic complementarity or extrinsic substitutability between the private good and the public good. The right-hand side of equation (8) is decreasing in  $P$ , i.e.,  $g_P^* < 0$  for all  $P$  if  $x$  and  $G$  are extrinsic complements, while it is increasing in  $P$ , i.e.,  $g_P^* > 0$  for all  $P$  if  $x$  and  $G$  are extrinsic substitutes. We categorize the former as Case I and the latter as Case II. Cases I and II are respectively illustrated in Figures 1 and 2, in which the right-hand side and the left-hand side of the equilibrium condition (8) are drawn as a dotted line and a thick line, respectively. From the analysis based on the graphs, the condition that the slope of the right-hand side is less than unity, i.e.,  $g_P^* < 1$  for all  $P > 0$ , guarantees the uniqueness and stability of the equilibrium. This condition requires that a one dollar increase in the conjecture of total private provision does not raise the ex-ante private provision by more than one dollar, that is, people's response to an increase in their conjecture is not relatively large to the positive side.

To check the stability, we suppose that the conjecture of total private provision,  $P^c$ , is larger than the equilibrium level,  $\hat{P}(D)$ . In this case, the conjecture of total private provision is larger than the ex-ante total private provision that is based on this conjecture, i.e.,  $P^c > g^*(P^c, h(D), D)$ . This in turn enforces individuals to revise their conjecture downwards. On the other hand, we suppose that the conjecture of total private provision,  $P^c$ , is smaller than the equilibrium level,  $\hat{P}(D)$ . In this case, the conjecture of total private provision is smaller than the ex-ante total private provision that is based on this conjecture, i.e.,  $P^c < g^*(P^c, h(D), D)$ . This in turn makes individuals to revise their conjecture upwards.

Notice that the extrinsic complementarity or substitutability plays an important role in whether or not an equilibrium is uniquely determined with stability. The extrinsic complementarity, as in Case I, implies  $g_P^* < 0$  so that there exists a unique (stable) equilibrium level of the public good,  $\hat{P}(D) > 0$ . In contrast, if the two goods are extrinsically substitutes, then it must hold that  $g_P^* > 0$  so that the uniqueness and stability of the equilibrium are not guaranteed, and the additional assumption  $g_P^* < 1$  must be required.

It is worth noting that there is the possibility of multiple equilibria under some conditions, as shown in Figure 3. In this case, the condition in Proposition 1 is violated for some  $P$ , and there are three equilibria, each of which attains different levels of total private provision. It can be seen that the equilibrium in the middle is unstable, while other two equilibria are stable. This multiplicity induces the indeterminacy of the resulting total private provision, which might provide an explanation of the possibility that total provision of the public good is different from case to case even though these seem to face almost identical environment. Although we admit such issues, in the rest of the paper we assume  $g_P^* < 1$  for all  $P > 0$  so that the uniqueness and stability of the equilibrium are satisfied.

### 3.3 Public Provision

This subsection studies the impact of public provision on total provision and private provision of the public good. To do this, we differentiate the equilibrium condition (8) with respect to  $D$ , which yields:

$$\hat{P}_D = \frac{g_h^*(\hat{P}, h(D), D)h'(D) + g_D^*(\hat{P}, h(D), D)}{1 - g_P^*(\hat{P}, h(D), D)}. \quad (9)$$

Equation (9) has important implications related to the crowd-out/in hypothesis. It can conventionally be said that public provision  $D$  induces crowd-out if  $\hat{P}_D < 0$ , and crowd-in if  $\hat{P}_D > 0$ . Then, we deduce the following results:

**Proposition 2** *Suppose  $g_P^*(P, h(D), D) < 1$  for all  $P > 0$ . Then, an increase in public provision  $D$  induces crowd-out if*

$$v_{xG}(\hat{x}(D), \hat{G}(D)) > v_{xx}(\hat{x}(D), \hat{G}(D)) + f_{gh}(\hat{P}(D), h(D))h'(D), \quad (10)$$

*and otherwise it induces crowd-in, where  $\hat{x}(D) = w - D - \hat{P}(D)$  and  $\hat{G}(D) = \hat{P}(D) + D$  respectively represents the consumption of the private good and total provision of the public good in an equilibrium.*

For a better understanding of the logic behind the result, we examine the equilibrium in Case I and Case II, separately. We first consider Case I ( $g_P^* \leq 0$ ) in which  $x$  and  $G$  are extrinsic complements or independent, i.e.,  $g^*$  is decreasing in  $P$ . In this case, it must hold that  $v_{xG} \geq 0 > v_{xx} + f_{gh}h'$ , which implies  $\hat{P}_D < 0$ , i.e., the economy never achieves crowd-in. The crowd-out phenomenon can be divided into two types, depending on its degree: the first is incomplete crowd-out, where an increase in public provision reduces total private provision but still increases total provision, i.e.,  $\hat{P}_D \in (-1, 0)$ ; and the second is over crowd-out, where an increase in public provision reduces total private provision as well as total provision, i.e.,  $\hat{P}_D < -1$ . By equation (9), we directly deduce the following result:

**Corollary 1** *Suppose that  $x$  and  $G$  are extrinsic complements or independent, i.e.,  $v_{xG} \geq 0$  for all  $x$  and  $G$ . Then, an increase in public provision  $D$  induces crowd-out. In particular, it induces over crowd-out if*

$$f_{gh}(\hat{P}(D), h(D))h'(D) < f_{gg}(\hat{P}(D), h(D)), \quad (11)$$

*and otherwise it induces incomplete crowd-out.*

Notice that there always exists a unique equilibrium if  $x$  and  $G$  are extrinsic complements or independent. This corollary says that the degree of crowd-out depends highly on the degree of motivational shift, or the absolute value of  $f_{gh}h'$ , when the two goods are intrinsic complements. If an increase in public provision induces a high degree of motivation-out for individuals, it could result in over crowd-out. In contrast, if an increase in public provision induces a low degree of motivation-out for individuals, it could result in incomplete crowd-out. Furthermore, the reason why crowd-in does not occur is related to the extrinsic complementarity, which implies that an increase in total provision associated with an increase in public provision makes voluntary contribution less attractive compared to the private good consumption.

We next consider Case II ( $0 < g_P^* < 1$ ), where  $x$  and  $G$  are extrinsic substitutes, i.e.,  $g^*$  is increasing in  $P$ . Then, we deduce the following result:

**Corollary 2** *Suppose  $g_P^*(P, h(D), D) < 1$  for all  $P > 0$ . Suppose also that  $x$  and  $G$  are extrinsic substitutes, i.e.,  $v_{xG} < 0$  for all  $x$  and  $G$ . Then, an increase in public provision  $D$  could induce crowd-out as well as crowd-in. In particular, it induces over crowd-out if both conditions (10) and (11) are satisfied; incomplete crowd-out if condition (10) is satisfied but condition (11) is not; and crowd-in if condition (10) is not satisfied.*<sup>9</sup>

Similar to Case I, if an increase in public provision induces a high degree of motivation-out for individuals such that conditions (10) and (11) are satisfied, it could result in over crowd-out. However, in contrast to Case I, since  $v_{xG} < 0$  could cause condition (10) to violate, crowd-in could also occur. In fact, if an increase in public provision induces only a small degree of motivation-out (small absolute value of  $f_{gh}h'$ ) and if the degree of extrinsic substitutability is relatively high (large absolute value of  $v_{xG}$ ), then condition(10) is violated so that crowd-in could occur. Notice that with the extrinsic substitutability, an increase in total provision associated with an increase in public provision makes voluntary contribution more attractive compared to the private good consumption for individuals. In the case of crowd-in, the positive impact of an increase in public provision through the extrinsic substitutability dominates the negative impact through motivation-out.

We now turn to a further inspection of a special case in which any motivational shift in the intrinsic payoff does not exist, i.e.,  $f_{gh} = 0$  or  $g_h^* = 0$ . Then, we obtain the following result:

**Corollary 3** *Suppose  $g_P^*(P, h(D), D) < 1$  for all  $P > 0$ . Suppose also that no motivational shift exists, i.e.,  $f_{gh} = 0$  for all  $g$  and  $h$ . Then, an increase in public provision  $D$  never*

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<sup>9</sup>It is shown that there is no case such that condition (11) is satisfied but condition (10) is not, because of the assumption of  $g_P^* < 1$  or  $v_{xG} > f_{gg} + v_{xx}$ .

induces over crowd-out. In particular, it induces incomplete crowd-out if

$$v_{xG}(\hat{x}(D), \hat{G}(D)) > v_{xx}(\hat{x}(D), \hat{G}(D)), \quad (12)$$

and otherwise it induces crowd-in.

This case may correspond to the standard impure altruism model. Without motivational shift associated with a change in public provision, over crowd-out never occurs. If  $x$  and  $G$  are extrinsic complements, then condition (12) must hold so that an increase in public provision must induce incomplete crowd-out, i.e.,  $\hat{P}_D \in (-1, 0)$ . In contrast, if  $x$  and  $G$  are extrinsic substitutes, then an increase in public provision induces either incomplete crowd-out or crowd-in, i.e.,  $\hat{P}_D > -1$ . In this case, whether incomplete crowd-out or crowd-in occurs depends highly on the degree of the extrinsic substitutability,  $v_{xG}$ .

Our results imply that the impact of a change in public provision of the public good highly depends not only on the motivational shift in the intrinsic payoff, but also on the characteristics of the public good in relation to the private good in the extrinsic payoff. If the motivational shift is large enough, public provision may reduce total provision as well as private provision in an equilibrium. In contrast, surprisingly, if the motivational shift is small enough, and if  $x$  and  $G$  are extrinsic substitutes, public provision may encourage people to increase private provision. Public provision increases the ex-ante total provision, which in turn causes individual contribution to become more attractive compared to the private good because of the extrinsic substitutability.

## 4 Conclusion

This paper has developed a theoretical model of voluntary contributions in a large economy. The model describes a situation where each individual implicitly realizes that “I belong to a large society, and the impact of my contribution on total provision is negligible.” Empirical evidence shows that a substantial portion of people still give positive contributions in

such a situation, and a variety of crowding-out/in results actually occurs. To explain such phenomena, we assume that the utility function consists of extrinsic and intrinsic payoffs.

Utilizing an equilibrium concept, in which people's conjectural total provision becomes consistent with the ex-post total provision, we incorporate the interplay between extrinsic and intrinsic payoffs caused by government intervention into the model. Previous literature suggests that government grants induce complete crowd-out in pure altruism models or incomplete crowd-out in impure altruism model. Contrary to these, the model provides the conditions under which public provision induces crowd-out as well as crowd-in within a single framework.

Our model could be considered one type of impure altruism models, since our focus is upon moral motivations as a component of intrinsic payoff. We show incomplete crowd-out in the absence of a motivational shift, which is identical to the result established in impure altruism models. However, we also provides a set of unique results in the presence of a motivational shift as well as the characteristics of a public good.

The intuitive implication from these results is that government grants may have unexpected adverse effects on total private provision when the private provision of a public good heavily relies on intrinsic motivation such as volunteer nursing for the elderly. This is because government intervention may destroy the internal motivation that drives such activities, and consequently it may even induce over crowd-out. Additionally, we also show that the characteristics of a public good is another key to determine the effects of government intervention. If a public good is an extrinsic substitute, like public radio stations, it may be possible that public provision increases total provision, i.e., crowd-in. If, however, a public good is an extrinsic complement such as many environmental goods, then it is more likely that an increase in public provision may decrease total provision. These results are due to the fact that the change in public provision alters the marginal benefit of private goods consumption in the extrinsic payoff.

This work could be extended in several directions. One possibility is to consider govern-

mental subsidies or tax deductibles for voluntary contributions. We believe that as subsidies or tax schemes change, it may affect both extrinsic and intrinsic motivation. However, there has not been much empirical or theoretical works on analyzing this issue in the presence of motivational shift. Some authors claim that monetary incentives do not necessarily increase and even reduce subjects' internal motivation (Frey and Oberholzer-Gee (1997) and Gneezy and Rustichini (2000)). The model outlined in this paper would hopefully be applied to explain the outcomes when there is some influence of government intervention on the internal motivation.

## References

- Andreoni, J. (1988). Privately provided public goods in a large economy: The limits of altruism. *Journal of public economics*, 35:57–73.
- Andreoni, J. (1989). Giving with impure altruism: Applications to charity and Ricardian equivalence. *Journal of political economy*, 97(6):1447–1558.
- Andreoni, J. (1990). Impure altruism and donations to public goods: A theory of warm-glow giving. *Economic journal*, 100:464–77.
- Andreoni, J. (2004). Philanthropy. In L. A. Gerard-Varet, S. K. and Ythier, J., editors, *Handbook of Giving, Reciprocity and Altruism*, pages 1–82. Elsevier.
- Benabou, R. and Tirole, J. (2003). Intrinsic and extrinsic motivation. *Review of economic studies*, 70:489–520.
- Brekke, K. A., Kverndokk, S., and Nyborg, K. (2003). An economic model of moral motivation. *Journal of public economics*, 87:1967–1983.
- Brennan, G. and Brooks, M. (2007). Esteem-based contributions and optimality in public goods supply. *Public choice*, 130:457–470.

- Cowen, T. (2002). The esteem theory of norms. *Public choice*, 113:211–224.
- Elster, J. (1989). *The Cement of Society—A Study of Social Order*. Cambridge University Press.
- Frey, B. S. and Meier, S. (2004). Pro-social behavior in a natural setting. *Journal of economic behavior and organization*, 54:65–88.
- Frey, B. S. and Oberholzer-Gee, F. (1997). The cost of price incentives: An empirical analysis of motivation crowding-out. *American economic review*, 87(4):746–755.
- Gneezy, U. and Rustichini, A. (2000). Pay enough or don't pay at all. *Quarterly journal of economics*, 115(3):791–810.
- Hollander, H. (1990). A social exchange approach to voluntary cooperation. *American economic review*, 80:1157–1167.
- Khanna, J. and Sandler, T. (2000). Partners in giving: The crowding-in effects of UK government grants. *European Economic Review*, 44:1543–1556.
- Le-Grand, J. (2003). *Motivation, Agency and Public Policy: Of Knights and Knaves, Pawns and Queens*. Oxford University Press.
- Lindbeck, A. (1997). Incentives and social norms in household behavior. *American economic review*, 87(2):370–377.
- Nyborg, K. and Rege, M. (2003). Does public policy crowd out private contributions to public goods? *Public choice*, 115:397–418.
- Okten, C. and Weisbrod, B. A. (2000). Determinants of donations in private nonprofit markets. *Journal of public economics*, 75:255–272.
- Payne, A. (1998). Does the government crowd-out private donations? *Journal of public economics*, 69:323–345.

- Poe, G. L., Clark, J. E., Rondeau, D., and Schulze, W. D. (2002). Provision point mechanism and field validity tests of contingent valuation. *Environmental and resource economics*, 23(1):105–131.
- Rege, M. (2004). Social norms and private provision of public goods. *Journal of Public Economic Theory*, 6(1):65–77.
- Ribar, D. C. and Wilhelm, M. O. (2002). Altruistic and joy of giving motivations in charitable behavior. *Journal of political economy*, 110:452–457.
- Roberts, R. D. (1984). A positive model of private charity and public transfers. *Journal of political economy*, 92:136–148.
- Rondeau, D., Poe, G. L., and Schulze, W. D. (2005). VCM or PPM?: A comparison of the efficiency properties of two voluntary public goods mechanisms. *Journal of public economics*, 89(8):1581–1592.
- Schram, A. (2000). Sorting out the seeking: The economics of individual motivations. *Public choice*, 103:231–258.
- Straub, J. D. (2004). Fundraising and crowd-out of charitable contributions: New evidence from contributions to public radio. Working Paper.
- Warr, P. G. (1982). Pareto optimal redistribution and private charity. *Journal of public economics*, 19:131–138.

Figure 1:  $g_P^* < 0$  for all  $P > 0$

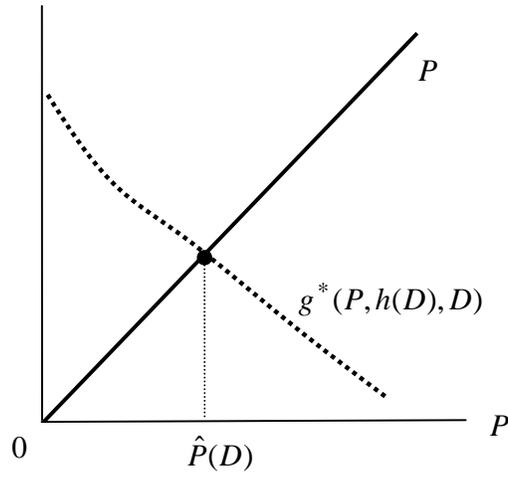


Figure 2:  $0 < g_P^* < 1$  for all  $P > 0$

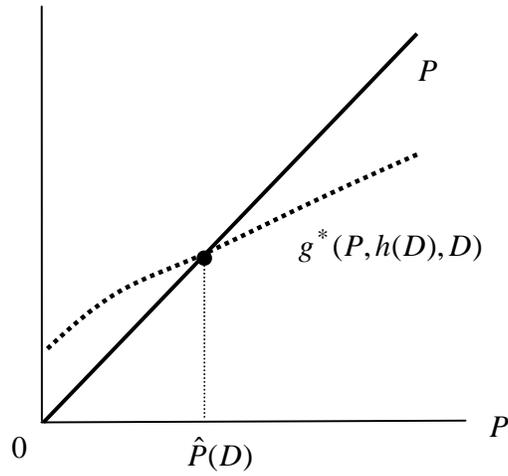


Figure 3: Multiple equilibria

