The B.E. Journal of Theoretical Economics

Contributions

Volume 9, *Issue* 1 2009 *Article* 14

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Recommended Citation
Paul B. Seabright (2009) "Continuous Preferences and Discontinuous Choices: How Altruists Respond to Incentives," *The B.E. Journal of Theoretical Economics*: Vol. 9: Iss. 1 (Contributions), Article 14.
Available at: http://www.bepress.com/bejte/vol9/iss1/art14

Continuous Preferences and Discontinuous Choices: How Altruists Respond to Incentives*

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Abstract

This paper models two discontinuities that have been claimed to constitute important exceptions to the standard economic theory of human motivation. The first is a discontinuity in the distribution across population types of the willingness to accept payment in return for certain services such as giving blood, because such services given free are more worthwhile than when performed for payment. The second is that people who give services free may refuse to sell them for some positive price (this is known as crowding out). The paper models both phenomena when individuals act to signal their type in a two-period game with assortative matching. The former is the unique equilibrium of a signaling game in which individuals announce the prices at which they will perform a civic action. The latter may be observed as one of two equilibria of a screening game in which individuals have only a binary participation decision available to signal their type.

KEYWORDS: crowding effect, intrinsic motivation, assortative matching, economic psychology, incentive schemes

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*I am grateful to the editor John Morgan and to an anonymous referee for very helpful advice and criticism, as well as to Emmanuelle Auriol, Roland Bénabou, Samuel Bowles, Ernst Fehr, Jennifer Gann, Patrick Rey, Jean Tirole and participants in the Workshop on Social Norms at the Wissenschaftskolleg Berlin for valuable discussions on these questions, and to Patricia Cunkelman for excellent copy-editing.

1 Introduction

Are people who demand very small bribes almost as honest as people who demand none? Is selling something for a very low price almost equivalent to giving it as a gift? If not, could large qualitative differences between two situations that differ only with respect to some trifling monetary sum explain why offering someone a small fee might make an individual unwilling to do something she would gladly have undertaken for free?

There is growing experimental literature (testing a longer established folklore) on crowding-out effects. Supposedly, these are reductions in an individual's willingness to undertake certain socially valuable actions once these actions are made subject to explicit, usually monetary, rewards. Economists brought up on incentive theory tend to believe that a reward, no matter how small, is a genuine reward. Such a reward should be expected to increase, at least weakly, one's motivation and certainly not to decrease it. Yet, there is evidence that small rewards may sometimes be scorned by those to whom they are offered. Conversely, those who accept or solicit small rewards may be disdained by others. More dramatically, some actions that would be considered intrinsically acceptable or even admirable could be considered tainted or repugnant when undertaken for a reward, even a large one. A striking example is the donation of a kidney, which is considered admirable when undertaken without reward, but "morally offensive and ethically indefensible" when undertaken for monetary gain, citing one contribution to the debate on the passage of the U.S. National Organ Transplant Act.[1]

The bulk of this literature has assumed an exogenous qualitative distinction in value between the two types of actions (those performed for a reward and those performed for free). It has sought to explain crowding out by arguing that explicit monetary rewards transform an action of one kind into an action of the other kind; it is the loss in intrinsic value that explains the adverse motivational effect. In this paper, in contrast, I develop a model where both the qualitative distinction in perceived value between the actions and the crowding-out effect are endogenous: they are consequences of signaling behavior by agents whose utility depends not just on the actions performed, but on the perception of their type by other agents.

To make sense of such phenomena, I propose a particular interpretation of

[1] See Gann (2001) who writes: "In September 1999 an individual offered his right kidney for sale on eBay, an internet based auctions site. In America, where there are over 47,000 patients awaiting kidney transplants, and where the average wait for a kidney transplant nearly doubled between 1988 and 1996, this excited considerable interest. The bidding had reached $5.8 million before being shut down by the administrators of eBay."

the notion of a qualitative distinction between actions performed for free and those performed for an explicit reward in terms of a discontinuity of behavior in the space of individual types. I contrast this with crowding out, which is interpreted as a discontinuity of behavior in the space of incentive payments for all members of some subset of individual types. These two kinds of behavioral discontinuity are quite different, although they are often confused in informal discussions. I propose a model of a game where each kind of discontinuity can arise in equilibrium, but under different specifications of the details of the game. Informally, the first might be dubbed "No Cheap Bribes"—some people accept large bribes, some accept no bribes, and no one takes very small bribes. Furthermore, the reactions of others to any intermediate case, if observed, tend to reinforce the discontinuity: people with a low but positive willingness-to-accept may be stigmatized as cheap, but people willing to act for free are considered admirable. The second discontinuity is crowding out: some people do things for free that they (the same people) refuse to do for a small fee, although for a large enough fee they might be persuaded to participate once more. These two discontinuities are, respectively, a discontinuity of actions in the space of types and a discontinuity of actions in the space of payments.

More precisely, suppose that individuals differ in type according to the intrinsic disutility they derive from performing some action. To aid intuition, I call this a civic action and think of it as creating positive social value, although this is not strictly necessary. Later in the paper I discuss alternative interpretations. Suppose an individual's disutility is a parameter continuously distributed across the population; we can call the individuals with relatively low values of the disutility altruistic. Then we can distinguish:

- The Type Discontinuity: the willingness of individuals to accept payment in return for performing the civic action is a discontinuous function of individual type with a discontinuity at a zero value of the function. Some individuals are willing to perform the action for free; some are willing to do so for at least some significant positive amount; none are willing to do so for less than this amount.

- The Payment Discontinuity: for some subset of the set of individual types, the individuals concerned are willing to perform the civic action for free, but are unwilling to do so for any sum less than some strictly positive amount.

Note that while the Type Discontinuity is evidently compatible with an entirely orthodox interpretation of willingness-to-accept, the Payment Discontinuity appears to cast doubt on the very concept of a willingness-to-accept,

according to which higher associated payments always make a given option more attractive. In fact, as discussed below, a framework that explains the Type Discontinuity can also reconcile the Payment Discontinuity with an orthodox interpretation of willingness-to-accept.

I develop a model in which individuals benefit from being believed by others to be relatively altruistic. I show that their expressed willingness-to-pay depends not only on the actual disutility they suffer from performing the civic action, but also from the degree of apparent altruism signaled by their action. The fact that there may be No Cheap Bribes follows from the fact that individuals who demand bribes have to demand ones that are large enough to compensate them for the costs of having revealed themselves to be bribe takers.[2] The possibility of crowding out follows because performing the civic action becomes less attractive once payment is received as participation sends a less valuable signal about the participating individuals' degrees of altruism. This does not mean that participation is not altruistic—it is not just signaling—because, in equilibrium, participation is a valuable signal of altruism if those who participate are, on average, more altruistic than those who do not. Wanting to signal that you are altruistic is not incompatible with being genuinely altruistic. Indeed, the signal is credible because it is easier for the genuinely altruistic to signal.

I also show that the Type Discontinuity arises in different circumstances from the Payment Discontinuity. The former can be observed in circumstances where individuals announce their own willingness-to-accept payment (e.g., in signaling games), while the latter is observed in circumstances where the terms are set by some other party (e.g., a blood transfusion agency), and individuals decide whether to participate on the terms proposed. The latter involves participating agents as second movers and, therefore, is better characterized as a screening game.

In section 2, I briefly survey evidence for the Type and Payment Discontinuities and discuss explanations that have been advanced for them, indicating carefully what my own explanation adds. Section 3 sets out the model and derives the main results. Section 4 summarizes and concludes.

[2]This depends, of course, on the bribe taker's caring enough about signaling herself as altruistic, an assumption that may not be realistic. My wife once successfully resisted paying a bribe to a public official in a country she was visiting and was begged by the official not to reveal this fact because it would make it harder for him to demand bribes from others in the future.

2 The Two Discontinuities: Evidence and Explanations

So what evidence is there for the Type and Payment Discontinuities? Of the two, the Type Discontinuity has been subject to much less careful investigation. The evidence for it is relatively casual and anecdotal and often regarded as obvious, as in the discussion of kidneys cited above. Anderson (1995) discusses a number of pertinent cases (e.g., commercial sex and surrogate parenthood), as do a number of contributors to Cullenberg & Pattanaik's (2004) anthology. It seems quite plausible that many people would not regard a politician who accepts a small bribe to do something for his constituents as being almost as honest as the politician who does the same work for free, or a kidney donor who sold his kidney for a small sum as being almost as admirable as a person who donated it for free. However, rigorous scientific tests of such intuitions are hard to find.

Many of the contributors to the more substantial literature on Payment Discontinuity have taken it for granted that their findings support something like the Type Discontinuity. Indeed, a number of writers, beginning most famously with Richard Titmuss (1970), have made claims that can be interpreted as one discontinuity and sometimes as the other. Titmuss himself wrote about the market for blood transfusions and focused on what he claimed were the adverse effects of paying donors. The evidence he cited was based on a somewhat broad-brush comparison between the British and U.S. blood transfusion systems. He claimed that in the U.S. system blood was provided predominantly by those who needed to donate for financial reasons, and this blood was likely to be medically much less suitable than blood donated by an average member of the population; this is clearly a claim about the Type Discontinuity. In addition, he conjectured that the low level of donations in the U.S. by more prosperous donors (when compared to the UK system) was the result of being paid for blood donations (rather than other differences between the systems or the national cultures concerned); this is a claim about the Payment Discontinuity.

Titmuss himself did not provide detailed empirical evidence in support of his claim. However, other authors such as Solow (1971) and Arrow (1972) agreed with him that altruistic motivation might be important, but they assumed that price incentives could be regarded as additives so that the supply curve for blood would be positively sloped in the standard way. Interestingly, little of the substantial later work on crowding out has sought to test Titmuss's original claim about the market for blood. Upton (1973) found evidence of re-

duced donations from regular blood donors who were offered an additional $10 in compensation. More recently, Mellström & Johannesson (2008) undertook a controlled experiment with inconclusive results: potential blood donors who were offered a small payment showed a lower willingness to donate than either a control group that was offered no such payment or another treatment group who was offered the opportunity to donate the payment to charity. However, these differences were not significant at conventional levels, although there was a statistically significant crowding-out effect among female subjects (though it is unclear why women should be particularly inclined to crowding out).

Empirical work in other contexts by a number of researchers suggests the possibility of crowding out should be taken very seriously (see Frey & Jegen, 2001, for an overview, and Bowles & Hwang, 2008, for a survey and discussion of the implications for public economics). However, interpretation of this work is complicated by the fact that the type of motivation is likely to vary substantially between contexts. One of the best known early studies was by Deci (1971) who suggested that paying experimental subjects to solve puzzles during an experiment decreases their subsequent willingness to solve such puzzles for fun. Although this finding has often been interpreted in terms of the crowding out of the intrinsic motivation for puzzle solving by a financial motivation, there does not seem to be anything particularly civic about such a motivation. Thus, it remains unclear whether there are lessons for contexts closer to those of Titmuss. In particular, one possible interpretation of Deci's results is that subjects saw the payment as a signal about the likely character of the work.[3]

In a more closely related context, Gneezy & Rustichini (2000a) show that when children doing volunteer work (going from house to house collecting donations for charity) are paid a small monetary reward, the intensity with which they work declines, although it recovers again with subsequent increases in the level of payment. They call the effect "pay enough or don't pay at all," and, although this can be interpreted as a crowding-out effect, a similar phrase might be used to describe the Type Discontinuity. The same authors (Gneezy & Rustichini, 2000b) also report an experiment in which the introduction of a fine for parents who collected their children late from kindergarten increased the rate of late collection. They interpret this not strictly as a crowding-out effect, but as being due to the fact that the possibility of paying for late collection reduces the perceived element of social disapproval; it signals that

[3]One possibility is that the subjects came to expect that solving puzzles would be accompanied by a reward, and, when this expectation did not hold true, they withdrew their cooperation in retaliation.

lateness is not as costly to the kindergarten staff as it had previously been thought to be.

Frey, Oberholzer-Gee & Eichenberger (1996) and Frey & Oberholzer-Gee (1997) have suggested that the willingness of individuals to contribute to the public good may be undermined by explicit payments. In particular, they draw on survey evidence of people's willingness to accept privately noxious, but socially necessary facilities (such as nuclear waste recycling plants). This evidence reveals that offering compensation does not increase the acceptability of such projects and, indeed, often elicits complaints about bribery. The authors interpret these findings as due to the crowding out of public spirit by private incentives.

There remain many unresolved issues about how to interpret these findings (see Fehr & Falk, 2001). Some of these unresolved issues are directly empirical, that is, whether the reported willingness-to-accept is a reliable indicator of the actual willingness-to-accept in practice. There are significant discrepancies between the two in the results reported by Frey, Oberholzer-Gee & Eichenberger (1996), some of which have to do with the difficulty of designing experiments to control for effects other than those that can be strictly described as crowding out (often negative reciprocity and loss aversion may be present in the same context, e.g., see Fehr & Falk, 2001, p. 37). Some have to do with the difficulty of knowing what signals are being perceived by the subjects in the experimental contexts. These include signals about the social norms that are relevant to that context and signals relevant to the likely costs of the behavior being elicited, such as the likely toxicity of a recycling plant. This difficulty therefore extends to knowing which nonexperimental settings could be considered relevant. Nevertheless, prima facie evidence for crowding out has appeared often enough for it to be worth considering what motivational foundations could explain such a phenomenon.

Most theoretical explanations appeal to the presence of two distinct motivational sources, sometimes known as extrinsic and intrinsic motivation. The first suggests that the actions concerned are performed in order to achieve some other end (such as payment), while the second suggests that the action yields satisfaction or pleasure in itself. For reasons that are then usually taken as exogenous, the nature of the extrinsic motivation interacts with the strength of the intrinsic motivation in some way with the two nevertheless remaining quite distinct arguments of the utility function.[4] For instance, Frey

[4]This is not true of Bénabou & Tirole (2003) who suggest an interesting mechanism whereby offers of explicit incentives by an informed principal signals something to an agent about her own type, and this type of information interacts with intrinsic motivation. In the model of this paper, in contrast, the principal has no private information.

& Oberholzer-Gee (1997) suppose that individuals gain utility from ordinary consumption (and thereby indirectly from money) and also from behaving in an altruistic manner or living up to their civic duty. Offering payment for actions that are thought to be part of an individual's civic duty increases that person's consumption possibilities, but reduces the utility from behaving altruistically. Therefore, it may reduce an individual's utility overall and also the willingness to undertake such actions. A similar mechanism is invoked by Gann (2001) to explain a reduced supply of blood when payments are made. Giving blood and selling blood are considered two distinct kinds of activity; the former yields some intrinsic utility, but not the other. When a payment is offered, it transforms the former activity into the latter, implying a utility loss.

While there is much to be said for this theoretical approach, it would be helpful to know the origin of these differences in the perception of activities. It is certainly plausible that individuals may be altruistically motivated.[5] Whether this motivation is best captured by adding arguments to the utility function depends on the problem (there are clearly some kinds of altruism that do not increase a person's well-being because they reflect duty rather than delight, and they may move the individual to action even though she may heartily wish she did not have that particular duty).[6] However, it would be good to know why feelings of altruism sometimes attach themselves to actions performed purely under certain conditions, and why another action with identical consequences might not elicit altruistic feelings even when the person concerned knows that the consequences are the same. Framing effects such as these are not necessarily implausible (framing is a pervasive experimental phenomenon),[7] but they certainly invite further explanation. What is needed, therefore, is a more general account of why two actions may be described in ways that elicit such different reactions, and why such descriptions could be stable under reflective consideration of the consequences.[8] This is not an objection to theories of virtue ethics where the ethical life is thought to consist of living according to a number of distinct virtues that cannot be reduced to

[5] There are also many examples of individuals creating public goods for free when these arise as by-products of activities that are privately valuable for them. See Bessen (2001) on the open-source software movement.

[6] A similar point underlies Sen's famous distinction between "sympathy" and "commitment" (Sen, 1977).

[7] See, most obviously, Kahneman & Tversky (1986).

[8] Robert Nozick (1974, p. 234) replied to an argument of Bernard Williams about doctoring being an activity that was intrinsically about curing patients by asking what distinguished it from "schmoctoring," which was just like doctoring except that its purpose was to make money for the practitioners.

some common objective. It is an objection only to those versions of virtue ethics that insist there is nothing further to be said about why we come to value the virtues that we do.

Without an explanation of the origin of these differences in perception, the theory would also seem to imply considerable shortsightedness on the part of individual decision makers. An individual who wants to continue to enjoy the warm glow attached to performing a civic duty could simply give the money to a charity and continue to think of the action as not only a performance of civic duty, but also a form of raising money for a good cause. There is a lot of anecdotal evidence that in some contexts people do indeed reason this way (some academic journals encourage this by paying referees a fairly miserable fee and then invite them to donate the fee to charity, which makes sense in light of the findings of Mellstrom and Johanneson, 2008). Nevertheless, if people always reasoned this way, there would be no crowding-out effect. It is hard to think that crowding out arises, if indeed it does, simply because it never occurs to the agents unless they are specifically told that they could do something with their payment other than keep it.

I propose here that one reason why individuals may reject monetary payments for actions they would perform for free is that it enables them to send a signal to other individuals about the type of person they are.[9] I model this process as though the individuals concerned consciously calculate the benefits from their signaling behavior when deciding what monetary payments to request, accept or reject.[10] However, this model could also be interpreted, less literally, as a parable for the process that ensures that a tendency to behave in this way could come to be reinforced in individuals and selected for (genetically, culturally or both) in the behavior of the overall population.[11]

[9] This does not rule out the possibility that individuals may also want to send signals to themselves (see Benabou & Tirole, 2003). In principle, one could imagine two main kinds of rationale. One, which is compatible with modern evolutionary psychology, is that individuals may have within themselves multiple centers of cognition and reasoning and find it valuable sometimes to communicate through the external world rather than internal neural channels, perhaps because internal communication suffers from a lack of credibility. I tell myself that I am rich, good looking and successful; to silence the skepticism of my inner voice, I behave in ways that make it seem more likely to myself that I am indeed rich, good looking and successful. Another explanation is that consumers may find out about their own characteristics through consumption decisions: I do not know how fit I am until I go to the gym, I do not know whether I like caviar until I try it, and so on.

[10] Other examples of such signaling behavior are discussed in Bernheim (1994), though the applications and phenomena used to explain the behavior are very different. Bénabou & Tirole (2006) provide a comprehensive discussion of such signaling motivations.

[11] Gintis, Smith & Bowles (2002) modeled the genetic evolution of altruistic behavior via signaling that improves individuals' matching possibilities, though they do not explore issues

The key to the result is the way in which individuals benefit from being recognized by others as being a particular type, namely, the type that performs civic actions for free (this is defined endogenously in the model). If this simply enabled individuals to gain greater monetary rewards in the future, it is hard to see how it would be considered particularly meritorious. On the other hand, if it simply gave people greater psychic rewards, we would be relabeling the psychic rewards of performing one's civic duty as the psychic rewards of being recognized as performing one's civic duty.[12]

Instead, I propose that the main reward from signaling the performance of one's civic duty consists of the increased likelihood of subsequent interactions with other people who also perform their civic duty. Human social life is full of networking and interaction. Rarely do we interact with a whole mass of our fellow citizens; more often we interact with families, workgroups, societies, associations and all the multifarious institutions of a civil society. All these institutions benefit from reciprocal behavior, and the quality of life enjoyed in such institutions is determined not only by what you bring to the interaction yourself, but also by the kinds of people with whom you interact.

Much work has recently examined the characteristics of institutions where the benefits of belonging depend on an individual's characteristics and that of other members (Shimer & Smith, 2000). Such phenomena have been applied to understanding the growing inequality in household income (Deaton, 1995; Lerman, 1996), poverty traps in developing economies (Kremer, 1993), peer-group lending in poor countries (Ghatak, 1999), rising divorce rates (Weiss, 1993), transmission rates of HIV infection (Dow and Philipson, 1996), racial and class segregation in the schooling system (Benabou, 1994) and the changing employment structure of U.S. firms (Kremer & Maskin, 1996; Acemoglu, 1998; Mailath, Samuelson & Shaked, 2000). A key feature of such institutions is that they give rise to what is called assortative matching. High-scoring individuals on some relevant (utility- or productivity-enhancing) feature tend to match with other high-scoring individuals, and low-scoring individuals match with other low-scoring individuals. The reason for this is that, although everyone may want to match with the high-scoring individuals, those individuals

about type or payment discontinuities. They do not claim that such signaling behavior is the proximate motivation of the action, just that the preferences for such behavior were selected because of its fitness enhancing characteristics.

[12] Bénabou & Tirole (2006) show, however, that many experimental anomalies can be explained in a model in which agents care about material rewards, intrinsic motivation and reputation. Material rewards can contribute to a signal extraction problem that yields lower reputational benefits for reasons similar in spirit, although not in detail, to those in the present paper.

who are also high scorers have a greater ability to bid for such matches. One consequence is that low-scoring individuals suffer twice over—once from their own low score and once from the low score of the other individuals with whom they are obliged to interact.

In this model, therefore, I propose that individuals differ in the extent to which they derive benefits from performing some civic action. Individuals benefiting greatly from doing so and who can credibly signal that they do will tend to be matched in subsequent social interactions with other individuals who also benefit from performing the civic action. Both are likely to enjoy enhanced welfare as a result.

Thus, those individuals whose benefits from performing the civic action are above some threshold level will continue to do so for free, and all others will do so only for a fee. The fee demanded by those whose benefits are just below the threshold level is substantially above zero, and by revealing that they are not in the "civic virtue" group they forgo the chance of associating with highly civic-minded individuals in the future.

Finally, it should be noted that this model does not claim to replace other purported explanations for crowding out, such as the overjustification hypothesis. This is where individuals place a strong value on self determination, which is threatened when they are given explicit incentives because they can no longer claim ownership of their actions.[13] Such explanations may or may not prove convincing in particular contexts. What the current model does is provide another reason for crowding out, which may reinforce other reasons in some contexts and substitute for them in others. As can be seen, it yields some empirical predictions that differ from other explanations. Namely, unlike the case of overjustification, this kind of crowding out most likely occurs for kinds of behavior that influence an individual's probability of making social, professional and personal matches, which are important to his future well-being.

3 The Model

In this model, there is a continuum of risk-neutral individuals who each live for two periods. There is no discounting. In the first period, they may choose to engage in a public (civic) activity. If they do so, they match with other individuals in the second period and engage in a private activity. If they choose not to engage in the civic activity, they play no further part in the game and receive a reservation utility of zero.

[13] See Lepper, Greene & Nisbett (1973).

The civic activity involves the individuals offering services for which they may, if they wish, set a price, subject to the constraint that they must meet all demand at that price. Demand is discrete. The unit demand per participating individual i is determined as follows:

$$\begin{array}{ll} D_i(p) = 0 & p > p^* \\ D_i(p) = 1 & 0 \leq p \leq p^* \\ D_i(p) = n & p < 0 \text{ and } n > 1 \end{array}$$

The precise character of these benefits plays no intrinsic part in the analysis that follows; therefore, it does not need to be explicitly defined. However, the fact that demand is discretely greater than unity at negative prices can be considered as following from an implicit assumption of free disposal. That is, if individuals were to offer to pay others to provide services for them, then others would demand the payment whether they wanted the service, and their demand would therefore be distinct from their intrinsic valuation of the good. For the moment, we assume nothing about the magnitude of n, but as shown below it can be seen that demand at negative prices has to be large enough (in a sense to be defined) to dissuade high types from offering negative prices in the signaling game.[14]

Individuals differ in the extent to which they are motivated by acting for the good of society. Specifically, θ_i is the individual's constant marginal benefit per unit of civic services provided. Since individuals differ solely with respect to this variable, it is also the individual's type. There is a distribution $F(\theta)$ of types θ along an interval $[\theta^L, \theta^H]$ where $\theta^L < c < \theta^H < 2c$, and c is the coefficient of the individual's quadratic cost of supplying civic services, which is equal to $c\left[D_i(p)\right]^2$. Thus, the most motivated individuals are those for whom the benefit of supplying the services exceeds the cost, but the cost is still important for them.

An individual i has a twice continuously differentiable utility function $U_i(m_i, \theta_i, \theta_j)$, where

m is the individual's holding of a money numeraire (sufficiently large to avoid problems associated with interpreting negative utility).

[14] If demand were continuous at zero, there would be no pooling of high types at zero prices, so Proposition 1 would no longer hold. This should not be seen as a shortcoming of the model, but rather as an explanation of the result. If payoffs were continuous in the action space, then chosen actions would be continuous in the type space; it is in some sense a truism that a discontinuity in chosen actions must come from somewhere. However, the discontinuity of demand in the action space is plausible because of the discrete character of demand (which is familiar in many applications of consumer theory). And, the fact that the "jump" at zero may be large is a plausible consequence of the free disposal assumption.

θ_i is the individual's type.

θ_j is the type of the individual with whom she is matched in the second period.

Utility is written as follows for participating individuals:

$$U_i(m, \theta_i, \theta_j) = m + \theta_i D_i(p) - c\left[D_i(p)\right]^2 + V(\theta_i, \theta_j) \tag{1}$$

with $\partial V(\theta_i, \theta_j)/\partial\theta_i > 0, \partial V(\theta_i, \theta_j)/\partial\theta_j > 0$, $\partial^2 V(\theta_i, \partial_j)/\partial\theta_i\partial\theta_j > 0$.

The utility $V(.)$ from the private activity is therefore a function of the types of both the individual and the matched partner. We assume that the matching process in the second period randomly matches those who have the same expected type conditional on their first-period action.[15] It is useful to define $v^H(\theta_i)$ as the expected utility of an individual of type θ_i in the second period if she pools with all weakly higher types $\theta_j \geq \theta_i$; that is, if she is *a posteriori* indistinguishable from and is therefore matched at random with one of the set of all individuals with types (weakly) higher than her own. Similarly define $v^L(\theta_i)$ as the expected utility of an individual of type θ_i in the second period if she pools with all (weakly) lower types $\theta_j \leq \theta_i$. We can also define $w^H(\theta_i, \theta_k)$ as the expected utility of an individual of type θ_i in the second period if she pools with all (weakly) higher types than type θ_k (not necessarily her own) and analogously $w^L(\theta_i, \theta_k)$ if she pools with all (weakly) lower types. Of course, $v^H(\theta_i) = w^H(\theta_i, \theta_k)$ and $v^L(\theta_i) = w^L(\theta_i, \theta_k)$ whenever $k = i$.

We assume the following conditions on values of $V(.)$:

$$v^H(\theta^L) \leq c - \theta^L \tag{2}$$

$$V(\theta^H, \theta^H) > p^* + v^L(\theta^H) \tag{3}$$

$$V(\theta^H, \theta^H) - v^L(\theta^H) < n(cn - \theta^H) \tag{4}$$

The first of these conditions implies that θ^L is sufficiently low so that at least the lowest-θ individuals will want to announce positive prices because

[15] We do not model the matching process explicitly, but draw on the standard findings in the literature.

even the attraction of pooling with all higher-θ individuals will not compensate them for the net costs of providing the civic service. The second condition implies that θ^H is sufficiently high so that at least the highest-θ individuals will want to announce zero prices. Together, these two conditions imply that there are some individuals who would prefer not to engage in the public activity without payment, while there are others who prefer to do so even without payment.

The third condition states that the benefit to even the highest-type individual of correctly revealing her type (as opposed to pooling with all lower types) is not large enough to outweigh the cost of providing civic services at a negative price, given the likely demand for them at that negative price.

Actions may take place in this model in one of two ways:

- The first is a signaling game where individuals announce a non-negative price p_i at which they would be willing to engage in the civic activity. In the second period, individuals are matched with each other.

- The second is a screening game where the public authority announces a price p' at which participation in the civic activity will be remunerated; all individuals who choose to participate receive this price.[16] Each individual announces a participation decision a_i after which participation takes place. Individuals are then matched with others according to their expected type conditional on their participation decision.

To summarize, in the signaling game, an action profile is a function $p_i = h(\theta_i, p^*)$ where $p_i \in (-\infty, +\infty)$. In the screening game, an action profile is a function $a_i = g(\theta_i, p')$ where $a_i \in \{0, 1\}$ and $a_i = 1$ denotes participation by i.

In both games, I look for a Nash Equilibrium, subject to the constraint that in the second period individuals are matched with those who have the same expected type conditional on their first-period action.[17]

I first show that, if condition 4 holds, there is no loss of generality in restricting announced prices in the signaling game to the interval $(0, p^*)$:[18]

Lemma 1: In the signaling game, if assumption 4 holds, agents receive the same payoffs when their action profile is restricted to the interval $p_i \in (0, p^*)$ as when they have an unrestricted action profile.

[16] The price p' need not be restricted to be no higher than p^* if for some reason the authority believes the civic service should be subsidized above the willingness to pay.

[17] This is not strictly a Perfect Bayesian Equilibrium because no actions are chosen in the second period, but the conditions on the expectations are the same as in a PBE.

[18] In earlier versions of this paper, this restriction was imposed exogenously and struck some readers as unnecessarily *ad hoc*.

Proof: An agent of type θ^L announcing $p_i > p^*$ faces zero demand even if she pools with all higher θ individuals. Therefore, she receives strictly lower utility than from announcing $p_i = p^*$ because $m + v^H(\theta^L) \leq m + c - \theta^L$. If true of θ^L, this is also true *a fortiori* of $\theta > \theta^L$. An individual of type θ^H announcing $p_i < 0$ faces demand n and, therefore, by assumption 4 has a negative payoff even if she is able to fully reveal her type, so any price $p_i < 0$ is dominated by $p_i = 0$. For the highest type, her highest second-period payoff comes when she fully reveals her type; any price $p_i < 0$ is also dominated by $p_i = 0$ if she does not fully reveal her type. If true of type θ^H, this is true a fortiori for all $\theta < \theta^H$. Therefore, for any type θ_i, any price $p_i > p^*$ is strictly dominated by $p_i = p^*$, and any price $p_i < 0$ is strictly dominated by $p_i = 0$. QED.

Next, I turn to the properties of the signaling game.

3.1 The Signaling Game

I first show that there exists a unique equilibrium of the signaling game prices in which prices announced are discontinuous in θ:

Proposition 1 ***(Type Discontinuity):*** *There exists a unique equilibrium of the signaling game in which there exists a threshold value θ^* and an interval $(0, P)$ with $P > 0$ such that all individuals of type $\theta > \theta^*$ announce a zero price, and all individuals of type $\theta \leq \theta^*$ announce prices that are strictly greater than P with no individuals announcing prices in the interval $(0, P)$.*

Proof. I first assume, and later prove, that all and only the individuals with a type above some threshold value θ^* announce zero prices. Then, in equilibrium, each will be matched in the second period with an individual chosen at random from all those whose type is higher than θ^*. The expected utility of an individual announcing a price of zero is:

(5)
$$E[U_i(m_i, c_i, b_i, \theta_i, \theta)|p_i = 0] = m_i - c + \theta_i + \frac{1}{1 - F(\theta^*)} \int_{\theta^*}^{\theta^H} V(\theta_i, \theta_j) f(\theta_j) d\theta_j$$

An individual who announces a positive price, however, will be matched with another individual who has announced the same price, and who therefore reveals herself to be the same type. To see this, first define $\phi(p, \theta_i)$ as follows:

(6)
$$V(\theta_i, \phi(p, \theta_i)) \equiv E\lfloor V(\theta_i, \theta_j)|p_j = p \rfloor$$

Intuitively, $\phi(p, \theta_i)$ can be interpreted as the "certainty equivalent type" with whom, if type θ_i were paired, she would receive the same utility as the expected utility she receives from being matched randomly with all those with whom she in fact pools conditional on announcing price p. Now, write her expected utility from announcing a price p_i as follows:

$$E[U_i(m_i, c_i, b_i, \theta_i, \theta_j)|p_i > 0] = m_i - c + p_i + \theta_i + V(\theta_i, \phi(p_i, \theta_i)) \tag{7}$$

If she is maximizing her utility, we can write the first-order condition as follows:

$$-1 = \frac{\partial V(\partial_i, \phi(p_i, \theta_i))}{\partial \phi} . \frac{\partial(\phi(p_i, \theta_i))}{\partial p_i} \tag{8}$$

However, we also know from the conditions on the utility function that

$$\frac{\partial^2 V(\theta_i, \phi(p_i, \theta_i))}{\partial \phi \partial \theta_i} > 0 \tag{9}$$

from which we know that equation (8) will not be satisfied by the same value of p_i at any two different values of θ_i. Given that her announcement perfectly reveals her type she will therefore be matched with an individual of her own type. In equilibrium, her expected utility can be written as follows:

$$E[U_i(m_i, c_i, b_i, \theta_i, \theta_j)|p_i > 0] = m_i + p_i - c + \theta_i + V(\theta_i, \theta_i) \tag{10}$$

Define an individual of type θ^* as one who is just indifferent between announcing a zero price and announcing the positive price that maximizes her expected utility. For such an individual, setting equations (2) and (7) equal yields:

$$\frac{1}{1 - F(\theta^*)} \int_{\theta^*}^{\theta^H} V(\theta^*, \theta_j) f(\theta_j) d\theta_j = p_i + V(\theta^*, \theta^*) \tag{11}$$

from which it follows that p_i must be strictly greater than zero. Denote this value by $p_i(\theta^*)$.It also follows that θ^* is unique (since $V(.)$ is strictly increasing in both arguments); therefore, $P = p_i(\theta^*)$ is also unique.

It remains to be shown, first, that if an individual of type θ_i announces a zero price, then all individuals of type $\theta_i > \theta_i$ also do so (the assumptions on θ^L and θ^H ensure that such an individual exists and also that not all individuals announce zero prices). The assertion follows from differentiating equation (8) and using equation (9) to show that

$$\frac{\partial^2 V(\phi(p_i, \theta_i))}{\partial p_i \partial \theta_i} < 0 \tag{12}$$

Thus, if any individual of type θ_i is dissuaded from announcing a positive price by the reduction in the expected quality of her match, an individual of higher type will be even more dissuaded. The fact that the utility function is linear in money ensures that the higher type cannot be recompensed for this by a higher marginal utility of money. QED. ■

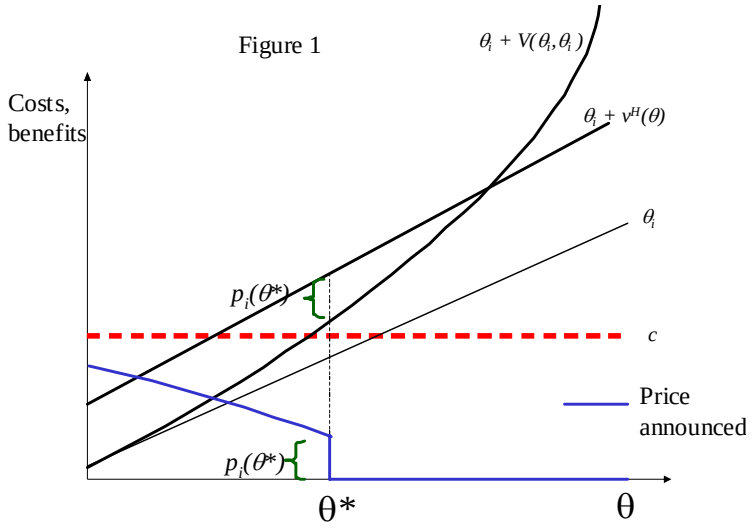

Figure 1 illustrates. The broken horizontal line represents the cost of participating in the civic activity while the two positively sloped dark lines represent the benefits (summed over both periods) under alternative assumptions about matching in the second period. The convex line shows the benefit of participation under the hypothesis that the individual is matched precisely with another of her type (this is "separation"). The straight line is the benefit of participation under the assumption that the individual is matched at random with the set of individuals that are of a weakly higher type than her

(this is "pooling"). (The fact that one is drawn convex and the other straight is unimportant; what matters is that the former is steeper than the latter.) For the highest values of θ, the individual would prefer perfect matching, but is unable to find a way to signal her type. For values below where the two dark lines cross, the individual prefers pooling with other (higher) types, until we reach types below θ^*, at which point the positive price that the individual could announce while separating from the types lower than her own is just high enough to outweigh the benefits of pooling. At θ^*, this price is strictly positive because here the benefits of participation under perfect matching must be lower than the benefits under pooling with individuals of a higher type.

As drawn, this price yields significant rents to the individual of type θ^* because her gross benefits of participation are significantly higher than the costs. How large precisely will these rents be? The answer depends on p^*, the willingness to pay for the service. At that price, the marginal participant is the one for whom participation rents are zero, namely the one for whom $p^* - c + \theta + V(\theta, \theta) = 0$. Lemma 2 shows that under separation, rents to participation are strictly increasing in θ, so that all participants of a higher type than the marginal participant receive strictly positive rents.

Lemma 2: $R(\partial) \equiv \theta + V(\theta, \theta) + p_i(\theta) - c$ is increasing in θ.

Proof: From equation (8), we know that in equilibrium

$$\frac{\partial p_i}{\partial \phi_i} = -\frac{\partial V(\theta_i, \phi(p_i, \theta_i))}{\partial \phi_i} \tag{13}$$

where we write $\phi_i \equiv (p_i, \theta_i)$.

Totally differentiating $V(.)$ yields:

$$\frac{dV}{d\theta_i} = \frac{\partial V(\theta_i, \phi_i)}{\partial \theta_i} + \frac{\partial V(\theta_i, \phi_i)}{\partial \phi_i}\frac{\partial \phi_i}{\partial \theta_i} \tag{14}$$

Substituting equation (10) in (11) yields:

$$\frac{\partial p_i}{\partial \theta_i} = \frac{\partial V(\theta_i, \phi_i)}{\partial \theta_i} - \frac{\partial V}{\partial \theta_i} \tag{15}$$

Totally differentiating the expression for rent, substituting equation (12) and using the envelope theorem yields:

$$\frac{\partial R(\theta_i)}{\partial \theta_i} = 1 + \frac{\partial V(\theta_i, \phi_i)}{\partial \theta_i} > 0 \tag{16}$$

Figure 2

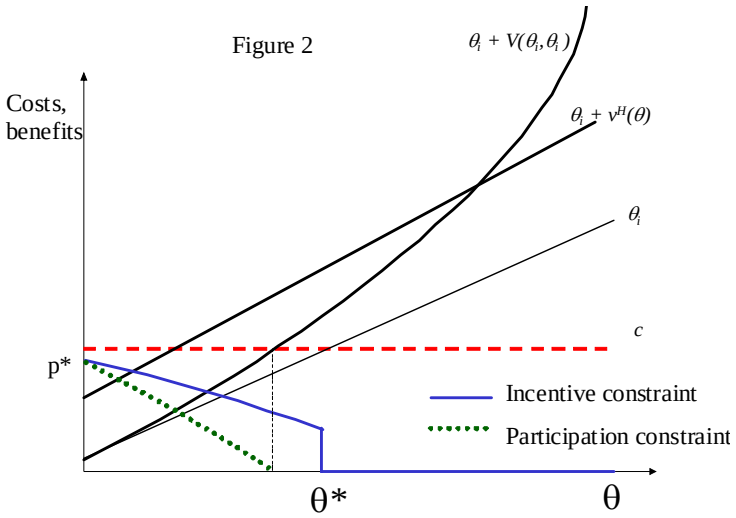

Figure 2 shows that the participation constraint is steeper than the incentive constraint, thus leaving participants who announce prices lower than p^* with a strictly positive rent. The participation constraint (the minimum price at which individuals will participate) reaches zero at the point where the horizontal line representing cost of participation cuts the curve representing benefits under separation. Here the actual announced price as determined by the incentive constraint is still strictly positive.

What about crowding out? Strictly speaking, crowding out cannot occur in the signaling game because it is a phenomenon that is properly defined only in the screening game where the public authority announces a price and individuals decide whether to participate as a result. However, we can define an analog that we can call p^*-crowding, which would occur if the proportion of individuals whose participation constraint is satisfied is strictly decreasing in p^*, the willingness to pay for civic services. However, it is easy to see that

Proposition 2 *There cannot be p^*-crowding in the signaling game.*

Proof. This follows immediately from Lemma 2, since if participation rents are strictly increasing in θ, the proportion of individuals whose participation constraint is satisfied is strictly increasing in the threshold price p^* (strictly increasing, since the individuals form a continuum). ■

Although very simple, the proposition has some importance because of what it tells us about the source of crowding out, which is that it arises in this

model through the signaling function of the participation decision. In the signaling game, however, all the necessary signaling is performed by announced prices, so the participation decision as such serves no signaling function. However, matters are quite different when we come to the screening game.

3.2 The Screening Game

Recall that in the screening game individuals are paid the price announced by the public authority, not the price they announce themselves. This means that, unlike in the signaling game, their participation decision is the only way they have to signal their type. Proposition 3 shows that, under these different conditions and given an additional assumption about payoffs, there will indeed be crowding out. This is because individuals with a high θ can signal this fact only by agreeing to participate when prices are zero and refusing to do so when prices are positive. For this to be a rational strategy, their gains from successful signaling have to increase faster in θ than their direct gains from participation. Proposition 3 states more precisely what it means for this latter condition to hold. First, however, it is useful to establish a preliminary property of any equilibrium of the screening game.

Lemma 3: In any equilibrium of the screening game, the subset of types participating and the subset of types declining to participate at any announced price are both connected subsets of the set of types.

Proof: The proof is by contradiction. Suppose that, for some announced price p', either the subset of types participating or the subset of types not participating is disconnected. Then the subset consists of at least two disjoint nonempty open intervals, and there exist two distinct types θ_1 and θ_2, each on the boundaries of one of the intervals, such that each is indifferent between participating and not participating. Without loss of generality let $\theta_1 > \theta_2$. Analogous to equation 6, define $\Phi(p, \theta_i)$ implicitly as follows:

$$V(\theta_i, \Phi(p, \theta_i)) \equiv E\left[V(\theta_i, \theta_j) | p' = p \;\&\; a_j = a_i = 1\right] \tag{17}$$

Intuitively, $\Phi(p, \theta_i)$ can be interpreted as the "certainty equivalent type" with whom if type θ_i were paired she would receive the same utility as the expected utility she receives from being matched randomly with all those with whom she in fact pools conditional on participating at an announced price p.

Then we can write the indifference conditions as

$$V\left(\theta_1, \Phi(p, \theta_1)\right) + p + \theta_1 - c = 0 \tag{18}$$

and

$$V\left(\theta_2, \Phi(p, \theta_2)\right) + p + \theta_2 - c = 0 \tag{19}$$

Since $\theta_1 > \theta_2$, these can be simultaneously satisfied only if $V\left(\theta_2, \Phi(p, \theta_2)\right) > V\left(\theta_1, \Phi(p, \theta_1)\right)$. However, since $V(\theta_i, \theta_j)$ is strictly increasing in θ_i, equation 17 implies that $V(\theta_i, \Phi(p, \theta_i))$ is also increasing in θ_i. Thus, $V\left(\theta_1, \Phi(p, \theta_1)\right) > V\left(\theta_2, \Phi(p, \theta_2)\right)$, contrary to assumption. QED.

Lemma 3 has an intuitive interpretation which is that for each announced price there will be some threshold type such that either every type above the threshold participates and every type below the threshold does not, or every type below the threshold participates and every type above does not.

Lemma 3 then enables us to prove that an equilibrium with crowding out exists in the Screening Game. First define θ^* as in Proposition 1. Next, define a price p_L that is the lowest price at which the lowest-value type θ_L will participate, conditional on all other types participating also. Define a price p_H as being the lowest price at which the lowest-value type θ_L will participate, conditional on being the only participant. From assumption (2) and from the fact that $v^H(\theta^L) > V(\theta^L, \theta^L)$, it follows that $0 < p_L < p_H$. We can now show:

Proposition 3 ***(Payment Discontinuity):***

If $\partial[w^H(\theta, \theta_k) - w^L(\theta, \theta_k)]/\partial\theta > 1$ *for all* θ_i*, then*

a) If the authority announces a price $p' = 0$*, there exists a unique equilibrium in which all and only individuals with* $\theta_i \geq \theta^*$ *participate in the civic activity.*

b) If the authority announces a price p' *such that* $0 < p' < p_L$*, there exists a unique equilibrium in which for some* $\theta' < \theta^*$ *all and only individuals with* $\theta_i \geq \theta'$ *participate in the civic activity.*

c) If the authority announces a price $p' \geq p_L$ *, there exists an equilibrium in which all individuals participate.*

d) If the authority announces a price $p' \geq p_H$ *, there are threshold values of* θ*, one for each price within the interval, such that there exists a second equilibrium in which all and only individuals with values lower than the threshold participate. There are no other equilibria.*

e) There is a nonempty interval of prices $p' \geq p_H$ *such that the proportion of individuals participating in the equilibrium described in d) is strictly lower than at* $p' = 0$*.*

Proof. a) At an equilibrium with price $p' = 0$, individual θ_L will not participate by assumption (2). Lemma 3 implies that therefore all and only

individuals with types higher than some threshold will participate because otherwise the set of nonparticipating individuals would be disconnected. This threshold must be θ^* by definition of θ^*. Lemma 3 also implies that this equilibrium must be unique.

b) The proof is the same as for a) except that for a price $0 < p' < p_L$ the threshold must lie below θ^* because the net payoff from participation is increasing in θ.

c) By definition of p_L, θ_L will participate conditional on believing that all others will participate. Since $w^H(\theta, \theta_k)$ is increasing in θ, all higher types will also participate conditional on the same belief. Thus, participation by all individuals is a Nash equilibrium.

d) Consider a price $p^+ \geq p_H$. Define θ^+ as the value of θ_i at which individual i is just indifferent between participating and not participating, conditional on believing that only individuals with values $\theta_j \leq \theta^+$ will participate. Then we can set the benefits of not participating equal to the benefits of participating, as follows:

$$v^H(\theta^+) = v^L(\theta^+) + \theta^+ - c + p^+ \tag{20}$$

which implies

$$v^H(\theta^+) - v^L(\theta^+) = \theta^+ + p^+ - c \tag{21}$$

Now consider the incentives for individuals with $\theta' \geq \theta^+$. If such individuals prefer not to participate, it must be true that

$$w^H(\theta', \theta^+) - w^L(\theta', \theta^+) \geq \theta' p^+ - c \tag{22}$$

We can rewrite equation (21) as:

$$w^H(\theta^+, \theta^+) - w^L(\theta^+, \theta^+) \geq \theta^+ + p^+ - c \tag{23}$$

which we can subtract from equation (22) to yield:

$$[w^H(\theta', \theta^+) - w^H(\theta^+, \theta^+)] - [w^L(\theta', \theta^+) - w^L(\theta^+, \theta^+)] \geq \theta' - \theta^+ \tag{24}$$

If $\partial[w^H(\theta, \theta_k) - w^L(\theta, \theta_k)]/\partial\theta > 1$ holds for all θ_k, then it holds in particular for $\theta_k = \theta^+$, implying that $\partial[w^H(\theta, \theta^+) - w^L(\theta, \theta^+)]/\partial\theta > 1)$, which in turn

implies equation (24). Thus, we can confirm that all individuals with $\theta < \theta^+$ will indeed participate while all those with $\theta \geq \theta^+$ will not, thus this strategy constitutes a Nash equilibrium. Lemma 3 implies that there are no other equilibria.

e) Because $V(.)$ has a positive cross-partial derivative we know that

$$(25) \qquad v^H(\theta^+) - v^L(\theta^+) > w^H(\theta', \theta^+) - w^L(\theta', \theta^+ \text{ for } \theta' > \theta^+$$

This implies that θ^+ is an increasing function of p^+. By setting $p^+ - p_L$ positive, but arbitrarily close to zero, we can make the proportion of individuals participating arbitrarily small. Define θ^C such that the proportion of individuals with $\theta < \theta^C$ is the same as the proportion of individuals with $\theta > \theta^*$ and define p^C such that $\theta^+ = \theta^C$ when $p^+ = p^C$. For any p' in the range $p_L < p' < p^C$, the proportion of individuals participating will be strictly lower than the proportion participating at $p' = 0$. QED ■

Figure 3

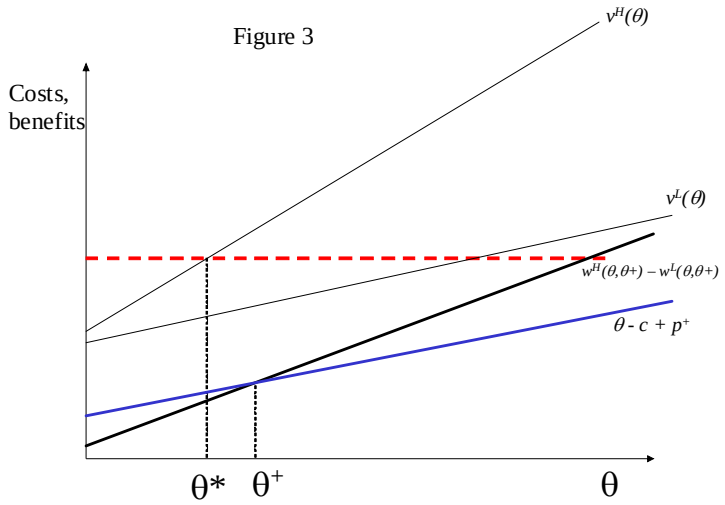

Figure 3 illustrates the equilibrium with crowding out, as described in e). The two thick lines show the benefits of participating (shallow line) and not participating (steep line); reductions in p^+ mean that θ^+ can be set arbitrarily close to θ_L.

To summarize, Type Discontinuity is observed in the signaling game, but Payment Discontinuity is not because for Payment Discontinuity to be observed (in this setting) requires participation itself (rather than the price of

participation) to act as a signal of an individual's type. Nevertheless, in a screening game in which price signaling plays no role, Payment Discontinuity can observed in an entirely intuitive way. However, it is only one of two equilibria, and whether it is observed depends on the expectations of individuals: there always exists an alternative equilibrium in which participation responds to prices in the conventional way.

To clarify the point, in a screening game, behavior may display crowding out—but only if individuals have reason to believe that refusal to participate when payment is offered will be matched by the same behavior on the part of other high-θ types.

4 Concluding Remarks

This paper has suggested that a qualitative and discontinuous difference between gifts and sales (or free participation in civic activities and participation for a price) can emerge from signaling behavior between individuals even without discontinuity in individuals' types. This is because individuals like to associate with others, and society's matching processes tend to associate like with like. Crowding out can also occur although in distinct circumstances where individuals do no signal through announced prices, but must do so via their participation decisions.

There are several empirical implications of the results that may help to determine whether the model is a useful one for explaining real-world phenomena. First, observation of both discontinuity and crowding out should require subjects to benefit from the signaling opportunities offered to them. Thus, both should be more likely to be observed if the civic activity results in observable signals (such as wearing a lapel badge to signal being a blood donor). Of course, self signaling should not be ruled out, but signaling to others should be expected to reinforce the phenomenon.

Second, crowding out is less likely to be observed when the context of the decision allows individuals many other means of signaling their commitment to civic virtue other than merely refusing to participate when a positive fee is offered. This may provide an explanation for the discrepancy in the results of Frey, Oberholzer-Gee & Eichenberger (1996) between the situations where respondents were asked to either state their willingness to accept payment for a waste disposal facility or vote by secret ballot on whether to accept an actual offer. Under a secret ballot, the opportunity to use a participation decision for signaling purposes was very limited.

Third, when crowding out is observed, the fact that it is one of two possi-

ble equilibria means we should expect to see some expectations coordination mechanism at work. We should expect to see, for instance, that refusal to participate when offered a payment is more likely if there has been some discussion among the participants (or in the media to which they have access) of the ethics of payment. There should, in other words, be "a culture of voluntarism" that would create an expectation that accepting a payment would be interpreted in a negative light.

One final observation is that the phenomena explored in this paper are by no means exotic or pathological. Most of us spend most of our time in association with others with whom our interactions are not governed entirely or even mainly by either market relations or explicit reciprocity. We do many things for which an immediate return is not calculated, but we value associating with those we like or admire. Understanding the difference between explicitly reciprocal interaction and implicit association is an important task for any satisfactory theory of social life.

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