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Comparing the first−best and second−best provision of a club good: an example.

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Abstract

Excludable and congestible shared goods − club goods (e.g., internet access facilities) − are more prevalent than Samuelsonian public goods. Our example shows that, unlike the usual presumption with pure public goods, the optimal second−best supply of a club good might exceed its first−best level. We argue that this arises because user charges can be levied on club goods; the government need not impose distortionary taxes to finance them. Thus, the first and second best in a club economy differ mainly because informational constraints prevent the government achieving the right income distribution in the latter.

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1. INTRODUCTION

A large literature compares the first-best (F-B) and second-best (S-B) supply of a pure public good [e.g., Atkinson and Stern (1974), Wildasin (1984), King (1986), Batina (1991), Wilson (1991a,b), Chang (2000)) and Gaube (2000)]. In the FB, a planner allocates private and shared goods as it wishes, constrained only by the economy's overall resources. In the SB, s/he uses distortionary financing of the shared good and household-specific budget constraints operate. This literature is still inconclusive but the presumption is of underprovision in the SB, both in the good's level and in that willingness to pay for a marginal unit supplied exceeds it marginal cost[1].

Buchanan (1965) club goods - e.g., swimming pools, internet services and tolled trunk roads - are congestible and excludable, as are most shared goods. Does the presumed relationship between FB and SB levels of a pure public good extends to clubs? We show, via a simple example that can be generalised, that a club good might well be overprovided in the SB if distributional considerations predominate in the FB. This finding is similar to Gaube's (2000) for a pure public good, but for different reasons.

Unlike a pure public good, which is of unvarying quality irrespective of the number of users, a club good varies in both the quantity and quality of provision (e.g., a swimming pool's size and average congestion level). So, to compare FB and SB provision levels, we need a notion of quality-adjusted quantity. We finesse this problem here by studying cases where FB and constrained SB levels of quality coincide, so comparison need be made only between the quantities of provision.

2. THE MODEL

We use the Fraser-Hollander model of SB clubs [cf.: Fraser and Hollander, Cornes and Sandler (1996), Fraser (2000)]. In this model, which builds on the approach of, e.g., Brito and Oakland (1980) and Fraser (1996) for excludable public goods, atomistic consumers confront a per visit price, facility size and conjectured quality for a club good. Taking these as parametric, they self-select to club membership. In a resulting Nash equilibrium, their simultaneous actions determine the club congestion, hence quality, which they face. In turn, an entrepreneurial club good supplier uses the demand schedule generated by the consumers' joint actions, which it (correctly) anticipates, to fix the optimal price and level of facility provision that fulfill its objectives.

Consider a single-club economy for simplicity.[2] There are N consumers, all with an identical utility function, $U[.]$, defined over the quantity, x, of a numeraire private commodity, visits to or use of a club good, v, and its quality, q. The private good is a necessity; the club good is not and need not be demanded at low incomes. To make the analysis interesting, we study cases where individuals with sufficiently low incomes will not choose the club good. We assume:

(A.1) U is strictly concave increasing in x, concave increasing in v and non-decreasing in q.

(A.2) Consumers' exogenously-given incomes $m \in \left[\underline{M}, \overline{M}\right]$ have a continuous density, $dF(m)$ (we ignore integer problems). $F(m)$ is known to the government

[1] See Gaube (2000) on this presumption.

[2] Even the most sophisticated comparisons of FB and SB provision of pure public goods that allow for many private goods [e.g., Gaube (2000)] consider only one public good.

or any other club supplier, but they cannot identify the income of anyone for tax or price discrimination purposes.

(A.3) A club's quality increases in its facility size, y, and decreases in aggregate utilisation, V: $\partial q(y,V)/\partial y \equiv q_1(y,V) > 0$; $\partial q(y,V)/\partial V \equiv q_2(y,V) < 0$

(A.4) $q(.)$ is homogeneous of degree zero in y and V: $q(y,V) \equiv q(y/V), q' > 0$.

NB: (i) with exogenous income, there are no incentive effects to providing and financing the club good; (ii) facility size is measured by the expenditure on the club: a unit of money buys a unit of "facility." (iii) If q is of the form (A.4), quality depends solely on the facility provision per use of the club. Only with this form will the FB "toll," if levied, make the club break even, whatever the population size [Kolm (1974); Mohring and Harwitz (1962)]. Here, the FB "toll" is club users' identical marginal willingness to pay for a marginal visit by foregoing private consumption and equals the value of the quality degradation the marginal visit imposes on club users.

Finally, we restrict attention to perhaps the simplest of the the families of utility functions for which optimal quality provision in the club is independent of the income distribution if (A.4) holds [Fraser (2000, 2005)]:

(A.5) All consumers have utility function (a) $U(x,v,q) \equiv u(x,vq)$.

Our results extend to other utilities for which optimal quality provision is independent of the the income distribution.

The First Best

In the FB, the government has full information about consumers' incomes. It can pool resources to get any allocation of goods, hence welfare, it thinks fit, subject to the economy's overall endowment. As all have the same U, it equalises utilities at the (x,v) bundle that maximises utility with all treated equally.

Let facility provision per use of the club be p - i.e., $p \equiv y/V$. By (A.4), $q = q(p)$. Adopt the normalisation $q(0) = 0$. Let $\overline{m}$ denote mean income and suppose (A.5)(a). The FB problem is:

$$\underset{p,v}{Max}.u\left[\overline{m} - pv, vq(p)\right] \tag{1}$$

Using (*) to indicate the FB, the two first-order conditions (FOC) characterising it are:

$$\left\{-u_1\left[\overline{m} - p^*v^*, v^*q(p^*)\right]p^* + u_2\left[\overline{m} - p^*v^*, v^*q(p^*)\right]q\left(p^*\right) \leq 0; v^* \geq 0\right\} \tag{2}$$

$$\left\{-u_1\left[\overline{m} - p^*v^*, v^*q(p^*)\right] + u_2\left[\overline{m} - p^*v^*, v^*q(p^*)\right]q'\left(p^*\right) \leq 0; p^* \geq 0\right\} \tag{3}$$

At an interior solution, the FOCs reduce to

$$p^*q'(p^*) = q\left(p^*\right) \tag{4}$$

This identifies the unique p^* with (A.5)(a). It is also the unique p^* for which the quality provision per unit of expenditure is maximised [Fraser (2000)]. Note also from (2) that, if $v^* = 0$,

$$-u_1(\overline{m},0)p^* + u_2(\overline{m},0)q(p^*) \leq 0 \tag{5}$$

If the club good is normal, when (5) holds with equality it identifies a unique mean income, m^* say, below which $v^* = 0$ and above which $v^* > 0$. The FB level of facility provision is then

$$y^* = Np^*v^* \tag{6}$$

The Second Best

Now, the government does not know each household's income and cannot redistribute. It can only fix the club's quality and, using the revenues from a break-even toll on it when consumers self-select, the overall provision. Non-excludability and the preference revelation problem means the government cannot charge directly for a pure public good in the SB. Rather, it must be financed by distortionary tax(es) on other goods. A club good's excludability means it can be charged for directly, mitigating both free riding and the need for distortionary taxes.[3]. Thus, the SB nature of the government's problem in supplying a club good lies mainly in that it cannot levy unrestricted lump sum taxes and thereby get the "right" income distribution. If everyone is identical and there are no distributional concerns, the FB and SB coincide in our club model, unlike with a pure public good.

Suppose now the government announces a toll p to finance the quality provision per visit. We can show [Fraser (2000)] that, given (A.4) and (A.5)(a), it will choose the FB p, p^*, in the SB.[4] A household with income m will then choose its club use to maximise utility, $u\left[m - p^*v, vq\left(p^*\right)\right]$, with the resulting FOC (with $**$ indicating SB magnitudes)[5]

$$\left\{-u_1\left[m - p^*v^{**}, v^{**}q(p^*)\right]p^* + u_2\left[m - p^*v^{**}, v^{**}q(p^*)\right]q\left(p^*\right) \leq 0; v^{**} \geq 0\right\} \quad (7)$$

Notice from (7) that the consumer with income m will not buy the club good if

$$-u_1(m,0)p^* + u_2(m,0)q(p^*) \leq 0 \quad (8)$$

Clearly, from (5) and (8) holding with equality, the m which leaves a consumer indifferent between making visits and not in the SB is the mean income which leaves the government indifferent between providing the club good and not in the FB. I.e., denoting the m which solves (9) with equality by m^{**}, $m^{**} = m^*$. So, were everyone identical, thus all had mean income $m = \overline{m}$, each would choose the FB level of club use, v^*, in the SB and we would have $y^* = y^{**}$.

With non-identical individuals, this suggests why we might expect $y^* < y^{**}$. Even if $\overline{m} \leq m^* = m^{**}$, thus $y^* = 0$, we will have $y^{**} > 0$ if some consumers have $m > m^{**}$. Of course, the comparison is only non-trivial if $\overline{m} > m^{**}$ - i.e., if mean income is high enough for the government to wish to supply the club good. We assume this from hereon.

If (8) holds with equality for an $m^{**} \in \left(\underline{M}, \overline{M}\right)$, all with income $m > m^{**}$ use the club and those with $m < m^{**}$ do not. Invert the first part of (7) as an equality to get club users' optimal usage, $v^{**}(m, p^*)$. The break-even SB level of club facility provision will then be

$$y^{**} = Np^* \int_{m^{**}}^{\overline{M}} v^{**}(m, p^*)dF(m) \quad (9)$$

[3] As the club is modelled as a luxury good, the government will not impose distortionary taxes on private goods to finance it.

[4] Our SB is a "constrained" SB as the government just raises as much from supplying the club good as it spends on it. It might do better than this if it were to "tax" the club good by charging for it more than it spends per visit and used the surplus to finance an identical cash transfer to everyone. But, then, the FB and SB $q's$ would not coincide, in general. We would then be forced to make a comparison of quantities *and* qualities in comparing the FB and the SB. Our initial tries at this have been inconclusive.

[5] An household will choose the v^{**} which maximises its utility and *then* choose to be a club user if, at that v^{**}, it obtains utility at least as great as from spending all its income on the private good. If utility is of different form from those in (A.5), an household might get utility which is less than that from consuming x alone at a $v > 0$ which satisfies the first part of (7) with equality. See Fraser and Hollander (2001).

3. AN EXAMPLE

To compare y^* given by (6) with y^{**} given by (9), we specialise $u(.)$ and F further. Suppose $u(.)$ takes the following form (the linear expenditure system allowing for zero club consumption):

(A.6) $u(x, vq) = (x - \overline{x})^{(1-\gamma)} (vq + \varepsilon)^{\gamma}$, for scalars $\overline{x}$, $\varepsilon > 0$, $1 > \gamma > 0$, $\overline{x} < \underline{M}$.

Suppose also that the population distribution function is Pareto with $\overline{M} = \infty$:

(A.7) $F(m) = \begin{cases} 0, & m < \underline{M} \\ 1 - (\underline{M}/m)^{\alpha}, & m \geq \underline{M} \end{cases}$

In (A.7), $\alpha > 0$ is a parameter; $\alpha > 2$ is needed for the variance of income to be well-defined. Mean income is $\overline{m} = \alpha \underline{M} / (\alpha - 1)$, thus $\alpha > 1$ is needed for $\overline{m}$ to be well-defined.[6]

At an interior solution, each consumer's optimal club usage in the FB is

$$v^* = \frac{\gamma}{p^*} (\overline{m} - \overline{x}) - \frac{(1-\gamma)}{q(p^*)} \varepsilon = \frac{\gamma}{p^*} \left[\left(\frac{\alpha}{\alpha - 1} \right) \underline{M} - \overline{x} \right] - \frac{(1-\gamma)}{q(p^*)} \varepsilon \equiv \frac{\gamma}{p^*} \left[\left(\frac{\alpha}{\alpha - 1} \right) \underline{M} - m^* \right] \tag{10}$$

where $v^* \geq 0$ requires

$$\overline{m} \geq \overline{x} + \frac{(1-\gamma) p^* \varepsilon}{\gamma q(p^*)} \equiv m^* \tag{11}$$

To make the problem interesting, assume that a strict inequality holds in (11). Then, in the FB,

$$y^* = N p^* v^* = \frac{\gamma N}{\alpha - 1} \left[\alpha \underline{M} - (\alpha - 1) m^* \right] \tag{12}$$

In the SB, a consumer with income m maximises utility to get optimal club usage of

$$v(m) = \frac{\gamma}{p^*} (m - \overline{x}) - \frac{(1-\gamma)}{q(p^*)} \varepsilon = \frac{\gamma}{p^*} (m - m^*) \tag{13}$$

(Again, $v(m) > 0$ if $m > m^*$.) Thus, the SB level of club provision is

$$y^{**} = N \int_{m^*}^{\infty} \gamma (m - m^*) \alpha \underline{M}^{\alpha} m^{-(1+\alpha)} dm = N \gamma \underline{M}^{\alpha} m^{*(1-\alpha)} / (\alpha - 1) \tag{14}$$

Hence

$$y^{**} - y^* = \tfrac{\gamma N}{\alpha - 1} \underline{M}^{\alpha} m^{*(1-\alpha)} - \tfrac{\gamma N}{\alpha - 1} \alpha \underline{M} + (\alpha - 1) m^*$$

$$= \left(\frac{\gamma N}{\alpha - 1} \right) m^{*(1-\alpha)} \left[\underline{M}^{\alpha} - m^{*\alpha} + \alpha m^{*(\alpha-1)} (m^* - \underline{M}) \right] \tag{15}$$

To sign $y^{**} - y^*$, we use the following theorem (proof available on request).

THEOREM 1. $\alpha > (1 - z^{\alpha}) / (1 - z)$ *if* $\alpha > 1, 1 > z > 0$.

Theorem 1 and (15) now enable us to prove our central result.

THEOREM 2. *If* $u(x, vq) = (x - \overline{x})^{(1-\gamma)} (vq + \varepsilon)^{\gamma}$ *and* $F(m)$ *is Pareto ((A.7)), then* $y^{**} > y^*$.

[6] See Degroot (1971) and Lambert (1993) on properties of the Pareto distribution.

Proof. From (15), $y^{**} > y^* \Leftrightarrow \alpha > m^{*(1-\alpha)} \left(m^{*\alpha} - \underline{M}^\alpha\right) / \left(m^* - \underline{M}\right)$

$$= m^* \left(\frac{m^{*\alpha}}{m^{*\alpha}} - \frac{\underline{M}^\alpha}{m^{*\alpha}} \right) / \left(m^* - \underline{M}\right) = \left[1 - \left(\frac{\underline{M}}{m^*} \right)^\alpha \right] / \left[1 - \left(\frac{\underline{M}}{m^*} \right) \right] \equiv (1 - z^\alpha) / (1 - z) \tag{16}$$

letting $z \equiv \underline{M}/m^* < 1$. For integer α, $(1 - z^\alpha) / (1 - z)$ is the sum to $\alpha - 1$ terms of a geometric series with first term 1 and common ratio of successive terms of $z < 1$. It is then easy to show that $\alpha > (1 - z^\alpha) / (1 - z)$ for integer $\alpha \geq 2$. For other α values, we use Theorem 1. As $\alpha > 2$ is needed for both the mean and variance of income to exist, (16) and Theorem 1 imply $y^{**} > y^*$. ∎

4. DISCUSSION AND CONCLUSION

Our example provides a simple illustration of the fact that club goods might not be underprovided in an SB. Clubs can be charged for directly; they need not be financed by distortionary taxes. Thus, the FB and SB differ in a club economy mainly because the government cannot get the correct income distribution in the SB due to imperfect information. In the SB, incomes differ and the relatively rich are more likely to buy the club good. The government fixes the size of the club facility to satisfy demand at the SB toll and quality. "Overprovision" can result from the need to meet the high club demand by the rich. Unlike a pure public good, the government cannot use the club good as a redistributive device as it cannot price discriminate (by assumption), not everyone uses it and those that do buy different amounts. So, while our explanation for overprovision in the club SB hinges on distributional considerations as does Gaube's for pure public goods, our mechanisms are different.

Our findings derive from a model in which FB and SB club "tolls" and qualities coincide; we only needed to compare the two facility sizes. Away from these circumstances, the government can still finance the club good by user charges rather than distortionary taxes if it wishes. FB and SB "tolls", qualities and facility sizes will then differ in general, but these differences will again primarily reflect distributional considerations [Fraser and Hollander (2001)].

Our results complement Scotchmer's (1985) and Manzini and Mariotti's (M&M, 2002). They also find "excesses" in aspects of club good supply. Scotchmer shows that the equilibrium number of firms that enter a market to supply a club facility exceeds the efficient number - there are *too many* clubs. M&M study of a three-consumer non-cooperative game of club formation finds a "tragedy of clubs": the excess entry of *members* into a single club. Both these analyses consider identical consumers (with M&M's consumers having market power). We consider atomistic, heterogeneous, price- and quality-taking ones. Unlike M&M's club, our club has *too few* members - it is the *provision* for them that is socially excessive.

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