Public Goods Provision: Lotteries, Provision Point Mechanisms and Voluntary Contribution Schemes

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1. Class Questions

2. Question 1

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Class Questions

1. Should lotteries be used more extensively to fund public-goods provision?
2. Are provision-point mechanisms more effective at providing public goods than voluntary-contribution schemes?
Types of Provision Mechanisms

- Lotteries/Raffles
  - Pari-mutuel
  - Fixed-prize

- Voluntary Contributions

- Provision Point Mechanism

- Auctions
Should lotteries be used more extensively to fund public-goods provision?


- Debate about use of lotteries as fund-raising mechanisms
  - Equity concerns
  - Efficiency concerns
- Examine lotteries relative to other "tax instruments"
  - Lotteries rather inequitable and ineffective means of revenue generation.
- Unfair comparison?
  - Lotteries not a substitute for confiscatory tax schemes
  - Often used in lieu of other voluntary contribution schemes
Why Lotteries?

- **Practical reason:** No tax or transfer power required (lotteries often held by private charities, civic groups lacking tax power).

- **Theoretical reasons:** Comparing lotteries to voluntary mechanisms; analysis is in the spirit of Cornes and Sandler (1984, 1994).
  
  - Introduction of *impure public good* with a linear price increases public good provision relative to pure public goods case.
  
  - Impure public good model has the property that outside donations to public good are non-neutral. In other words, government contributions/outside donations **do not** “completely crowd out” private donations.
Should We Use Lotteries?

- Compare equilibrium properties of different mechanisms under the same assumptions (Bergstrom & Cornes (1983))

- Relative to the standard voluntary contribution mechanism (VCM) under similar assumptions (mentioned in next slide), lotteries
  - Increase the provision of public good
  - Are welfare improving
  - Provide close to the first-best levels of public good as the size of lottery prize increases

- Wagers on lotteries lead to both a chance to win private prize and contribute to public good - type of *impure public good* setup

- Impact of lottery prize structure? **Fixed-prize vs Pari-Mutuel**
Assumptions

- Risk-neutral, non-altruistic, EU maximizing agents
- Separability of allocation and distributional concerns
  - Generally, efficient amount of public goods cannot be determined independently of the distribution of private goods
  - Such separation possible for consumers with “quasi-linear” preferences
- Lotteries linked to public good provision; this linkage affects betting behaviour
  - Empirical evidence: States that *earmark* the proceeds of lotteries to support certain public goods have higher average per capita lottery expenditures
- Social desirability of the public good being provided
Model

- \( N = \{1, 2, \ldots, n\} \) consumers/bettors

- Quasi-linear utility functions: \( U_i = w_i + h_i(G) \)
  \( w_i \): wealth of consumer \( i \) (numeraire good);
  \( G \in \mathbb{R}_+ \): level of public good provided;
  \( h_i'(\cdot) > 0, h_i''(\cdot) < 0 \ \forall i \): diminishing marginal utility from public good provision.

- **Fixed-Prize Raffles (FPR):**
  - Government/charitable organization chooses a fixed prize amount \( R \).
  - \( i^{th} \) consumer bets \( x_i \in [0, w_i] \)
  - Given the wagers of other contestants \( w_{-i} \), probability of \( i \) winning is \( \pi_i(x_i, x_{-i}) = \frac{x_i}{x(N)} \); where \( x(N) \): sum of all wagers
  - Public good provision \( G = x(N) - R \)
With quasi-linear preferences,

1. **VCM underprovide the public good relative to first-best levels**
   - Bettors don’t internalize the positive externality of their contribution on other consumers.
   - Voluntary contributions also suffer from multiplicity of equilibria.

2. **FPR provides more of public good than VCM**
   - Creates investment fund with negative externality component. More raffle tickets purchased by a bettor reduces chances of winning for others.
   - Compensates for the positive externality.

3. **FPR helps obtain a provision arbitrarily close to the first-best outcome.**
For FPR, neutrality does not hold (small donations increase total provision of public good, i.e. incomplete crowding out).

FPR provides positive amounts of public good iff good is socially desirable - alleviate free rider problem.

Equilibrium public goods provision in a pari-mutuel raffel exactly same as that obtained through voluntary contribution without provision point.

When public goods allocation decision can be separated from distribution decision, FPR increases public goods provision over VCM. Moreover, as the prize grows large, FPR provision converges to first-best from below.
Limitations?

- These results differ if lottery play motivated by **risk-seeking, love of gambling or ignorance** - The assumption that individuals pay attention to link between lottery wagering and public good provision is testable.

- Reduced taste for altruism or “warm glow” due to linkage between private gains from lottery and public goods provision.

- Lotteries can be regressive - adverse distributional effects override allocational gains. Interesting to study the trade-off between allocational versus distributional welfare gains.
Are provision-point mechanisms more effective at providing public goods than voluntary-contribution schemes?

*(VCM or PPM? A Comparison of the Performance of Two Voluntary Public Goods Mechanism: Rondeau et al. (2005))*
## VCM vs PPM

<table>
<thead>
<tr>
<th>VCM</th>
<th>PPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Threshold amount $T$ is common knowledge</td>
<td>1. Threshold/Provision point $T$ is common knowledge</td>
</tr>
<tr>
<td>2. Constant individual rate of return up to a maximum level $T$, no marginal benefit thereafter</td>
<td>2. Entire good provided only if total contributions equal or exceed project cost</td>
</tr>
<tr>
<td>3. No rebate of excess contributions</td>
<td>3. Contributions refunded if threshold not met. Proportional rebate rule applied to excess contributions</td>
</tr>
</tbody>
</table>
Experiment - Treatment Levels

- **Between group manipulations:**
  - Initial endowment \((w)\) - $10, $15, $18, $20
  - Threshold \((T)\) - $100 or $250
  - Subjects had knowledge about their initial endowments and that everyone in their group had an equal endowment.

- **Within group manipulations:**
  - Individual rates of return \((R^h)\) - \(R^h \in [0.004, 0.14]\)
  - Maximum personal payoff \(\in \{\$1, \$2, ..., \$14\}\)
  - Subjects knew their potential private payoff from the public good. Also know that other in their group may have different payoff amounts.
  - Actual size of groups unknown to participants.
Demand Revelation

\[
\text{Demand Revelation} = \frac{\text{Total Contributions}}{\text{Total Induced Value}}
\]

**PPM:** 63.9% to 135.3%
**VCM:** 41.2% to 80.7%

Alternate Measure: Median of Bid/Value Ratio

**PPM:** 0.60 to 1
**VCM:** 0.29 to 0.43

Fraction of induced value contributed to the public good consistently higher in the PPM.
Meta-analysis: Factors Affecting Contribution

Table 1
Analysis of mean and median bids across induced value ($T V_i$), mechanism (VCM v. PPM), endowment ($\omega$), and total cost (TC)

<table>
<thead>
<tr>
<th></th>
<th>Mean (S.D.) [range]</th>
<th>Means</th>
<th>Medians</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Long (S.E.)</td>
<td>Short 1 (S.E.)</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td>2.52 (1.38)</td>
<td>2.12** (0.50)</td>
</tr>
<tr>
<td>$V_i$</td>
<td>7.45 (4.25)</td>
<td>0.22** (0.05)</td>
<td>0.21** (0.05)</td>
</tr>
<tr>
<td>$D$(PPM)</td>
<td>0.50 (0.50)</td>
<td>0.76 (0.85)</td>
<td>0.74 (0.89)</td>
</tr>
<tr>
<td>[0,1]</td>
<td></td>
<td>(0,1)</td>
<td>(0,1)</td>
</tr>
<tr>
<td>$V_i*D$(PPM)</td>
<td>3.73 (4.81)</td>
<td>0.19* (0.08)</td>
<td>0.20* (0.08)</td>
</tr>
<tr>
<td>[0–14]</td>
<td></td>
<td>(0–14)</td>
<td>(0–14)</td>
</tr>
<tr>
<td>$\omega$</td>
<td>18.23 (2.54)</td>
<td>0.04 (0.07)</td>
<td>0.08 (0.07)</td>
</tr>
<tr>
<td>TC</td>
<td>220.97 (59.75)</td>
<td>−0.01 (0.00)</td>
<td>−0.01 (0.00)</td>
</tr>
<tr>
<td>[100–250]</td>
<td></td>
<td>(100–250)</td>
<td>(100–250)</td>
</tr>
<tr>
<td>$N$</td>
<td>62</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.67</td>
<td>0.67</td>
<td>0.66</td>
</tr>
</tbody>
</table>

* and ** mean significance at the 5% and 1% levels, respectively. Observations weighted by corresponding group size. Standard errors are Huber–White consistent as described in text.
Relative Efficiency of VCM and PPM

- 540 PPM and 504 VCM observations from treatments with threshold $250.
- Bootstrap estimates of the efficiency of both mechanisms.
- Randomly form groups comprising of 24 to 66 individuals.
- For each group size, 5000 PPM and 5000 VCM groups randomly formed keeping the number of subjects and distribution of induced values identical within each pair. Total 215,000 pairs (5000*43)
- With provision point of $250

\[
\text{Benefit-Cost Ratio (BCR)} = \frac{\text{Total Induced Value}}{\$250}
\]

- BCRs ranged between 0.416 to 2.48 (Average BCR = 1.36)
- VCM generated higher contributions in 4082 out of 215,000 pairs (1.9%)
Efficiency as Failures and Successes I

Fig. 2. Normalized aggregate contributions by BCR.
Figure A2
PPM Failure Rates by Benefit-Cost Ratio

![Graph showing PPM Failure Rates by Benefit-Cost Ratio with two lines: one for funded but should not and another for not funded but should.](image)
Most PPM failures are for desirable goods with relatively low BCRs - net welfare losses from non-provision of these goods disproportionately small.

**Total Surplus Captured:**
- PPM: $18.64 million (87.9%)
- VCM: $10.21 million (48.2%)

**Pairwise Comparison:**
- Surplus captured by VCM exceeds PPM surplus in 23.8% cases.
- Most of these cases arise from PPM’s failure to fund marginally desirable goods.
Alternate Comparison: Mean of Pairwise Difference in Surplus Captured

Figure A3
Mean Difference in Surplus Captured (PPM-VCM)
20 members of Cornell Council asked to contribute to an award.

- Commit to either VCM or PPM (same design as before).
- \( T = 1000 \)
- Finally, VCM implemented using a coin toss.
- Total Contributions pledged - VCM: $751, PPM: $941
PPM outperforms VCM for most values of BCRs across a number of efficiency measures.

Theoretically speaking, voluntary mechanisms with “provision points” can lead to first-best outcomes (Bagnoli & Lipman (1989), Admati & Perry (1991)).

Non-profits reluctant to implement PPM with money-back guarantee

- Risk of failure to fund a cherished project.
- Require commitment power on part of organizing agency to refund contributions in the event that threshold contribution level not reached.

Information about preferences needed to set the provision point appropriately to reach first-best outcome.
R. Cornes and T. Sandler.
Easy riders, joint production, and public goods.

J. Morgan.
Financing public goods by means of lotteries.

J. Morgan and M. Sefton.
Funding public goods with lotteries: experimental evidence.

D. Rondeau, G. L. Poe, and W. D. Schulze.
Vcm or ppm? a comparison of the performance of two voluntary public goods mechanisms.