Distributive Politics on Public Bads

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How to allocate the costs of public bads?

Public bads are byproducts of individuals' self-interested actions;

- The budget deficits due to the excessive private spending for locally-targeted projects $\Rightarrow$ insufficient public infrastructure.
- Firms' profit-maximizing decisions $\Rightarrow$ GHG emissions.

The costs induced by public bads need to be charged in a certain form of allocation of burdens (e.g., taxes), often resulting from political bargaining.

Research Question: How does posterior bargaining of the costs affect the voluntary production of public bads?

A Simple Model

(Not for advancing theory... but for organizing our thoughts.)

- Three players indexed by $i = \{1, 2, 3\} \equiv N$, two stages.
- 1st stage: Every player is endowed with $E > 0$ units of resource, and player i claims $g_i \in [0, E]$ for his/her own sake.
- The total sum of claims generates public bads, which incurs the costs of $C = \alpha \sum_i g_i$, $\alpha \in (0, 3)$.
- Everyone observes who claimed how much.

Interpret g_i as the activities beneficial to self but harmful to society, such as profitable productions that produce pollution. α describes how good/bad the production technology is for the environment.

Note that if $\alpha \in (0, 1)$, full contributions for the production of public bads maximize utilitarian welfare.

A Simple Model

- 2nd stage: A many-person ultimatum(*) to allocate the costs.
- One of the players is randomly selected with equal probability, and she proposed how to split the costs, $p \in \mathcal{P} = \{(p_1, p_2, p_3) \in [0,1]^3 | \sum_i p_i = 1\}$.
- If $q \in \{2, 3\}$ or more players vote for the proposal, it is approved, and player i accrues the payoff of $g_i - p_i$.
- Otherwise, player i accrues the payoff of $g_i - \frac{C}{2}$.
- $q = 2$: majority. $q = 3$: unanimity.

(* We could consider a many-person divide-the-penalty game (Kim and Lim, 2019), but the ultimatum is simpler representation while capturing the essence of legislative bargaining.)

Equilibrium When $q = 3$

Each player's strategy consists of

- the amount of claims,
- the proposal when selected as a proposer, and
- the voting decision when not selected as a proposer.

The subgame-perfect Nash equilibrium (SPE) is our solution concept.

Proposition

When $q = 3$, the essentially unique SPE is (1) for all i, $g_i^* = E$, (2) proposer i offers $p_i^* = 0$ and $p_j^* = \frac{1}{2}$ for $j \neq i$, and (3) non-proposer j votes for the proposal if $p_j^* \leq \frac{1}{2}$. The proposal is approved, as all players vote for it.

This result is regardless of the size of α.

Equilibrium When $q = 2$

When $q = 2$, there is a continuum of SPEa. This is distinctively different from political bargaining over public goods (Baranski, 2016).

- We focus on two "extreme" ones. (extreme in the sense that all other SPEa are between the two.)
- One equilibrium is practically identical to that when $q = 3$.

Corollary

When $q = 2$, the following strategy profile is a SPE: (1) For all i, $g_i^* = E$, (2) proposer i offers $p_i^* = 0$ and $p_j^* = \frac{1}{2}$ for $j \neq i$, and (3) non-proposer j votes for the proposal if $p_j^* \leq \frac{1}{2}$. The proposal is approved, as all players vote for it.

Equilibrium When $q = 2$

A distinctively different SPE may arise when

(1) the proposer distributes the entire costs to one non-proposer and

(2) when the proposer selects the one who bears the entire costs based on the first-stage observations.

Considering (1) doesn't drastically change the equilibrium prediction. Particularly, public bads are fully produced, $g_i^* = E \ \forall i$.

Proposition

When $q = 2$, the following strategy profile is another SPE: (1) For all i, $g_i^* = E$, (2) proposer i **randomly** *selects one non-proposer $k \neq i$ with equal probability and proposes $p_k^* = 1$ and $p_{-k}^* = 0$, and (3) player j votes for the proposal if $p_j^* \leq \frac{1}{2}$. The proposal is approved, as* **two** *players vote for it.*

Equilibrium When $q = 2$

A distinctively different SPE may arise when

(1) the proposer distributes the entire costs to one non-proposer and

(2) when the proposer selects the one who bears the entire costs based on the first-stage observations.

Considering (1) and (2) can drastically change the equilibrium prediction, given α is sufficiently large.

Proposition

When $q = 2$ and $\alpha > \frac{3}{2}$, the following strategy profile is another SPE: (1) For all i, $g_i^* = 0$, (2) proposer i picks player $k \neq i$ whose $g_k = \max_{j \in N \setminus \{i\}} g_j$, proposes $p_k^* = 1$ and $p_{-k}^* = 0$, and (3) non-proposer j votes for the proposal if $p_j^* \leq \frac{1}{2}$. In this equilibrium, the proposal is approved as all players vote for it.

Deterring Public Bads Production is Hard.

- When $q = 3$, everyone fully contributes to the production of public bads, regardless of the size of α.
- When $q = 2$, full production of public bads may sustain.
- Public bads production can be deterred only when three conditions hold.
  - Majority rule
  - Allocation of the entire costs to the one whose contribution was the largest.
  - The environmental harm of public bads is substantial.

Risk and social preferences?

Perhaps risk aversion and social preference may play a role. When $q = 2$, allocating half of the costs to two players

- is least "risky" (if the players perceive that the bargaining outcomes merely depend on the realization of the proposer selection) and
- lead to the least skewed allocation, which maximizes Rawlsian social welfare (given the same level of public bads)

than allocating the entire cost to one player. On top of that, when $\alpha > 1$, utilitarian social welfare decreases when public bads are produced.

Hypotheses

Altogether, we have the following testable hypotheses.

- When $q = 3$, public bads are fully produced.
- When $q = 2$ and $\alpha < 1$, public bads are fully produced.
- When $q = 2$ and $\alpha \in (1, 1.5)$, public bads production may decrease.
  - Observing $p = (0, 0, 1)$ in the previous bargaining round will decrease g_i.
- (not yet done) When $q = 2$ and $\alpha > 1.5$, public bads production may decrease.

Experimental Design

Treatment	**Voting Rule (q)**	**Cost Multiplier(α)**	**#Sessions**
U08	Unanimity (3)	0.8	2
U08	Majority (2)	0.8	2
U12	Unanimity (3)	1.2	3
M12	Majority (2)	1.2	3

(U16 and M16 will be conducted later.)

- The subjects are randomly and anonymously divided into groups of three. A group is endowed with 600 tokens in the group account. (Or, $E = 200$).
- 1st stage: Claim $g_i \in [0, 200]$. $C = \alpha \sum g_i$ is known.
- 2nd stage: Submit a proposal. One proposal is randomly selected and voted on. When the proposal is approved (i.e., q or more members vote for it), the costs are charged accordingly. Otherwise, $C/2$ is charged to everyone.
- Repeat this for 5 periods.

Results, so far

Treatment	Average Claim	Public bads
M08 (last 2 periods)	189.41 (193.29)	454.55 (463.88)
U08 (last 2 periods)	193.85 (199.38)	465.25 (478.50)
M12 (last 2 periods)	168.42 (172.46)	606.35 (620.88)
U12 (last 2 periods)	161.97 (173.06)	583.10 (623.00)

Table 1: Average claims and public bads

Social inefficiency ($\alpha > 1$) deters public bads production to some degree, but not sufficiently. See the total amount of public bads produced.

Results, so far

Grand-fair split: if the difference between maximum and minimum costs proposed is less than 10 tokens.

Treatment\Period	1	2	3	4	5
Majority	.1167	.1167	.05	.05	.0333
Unanimity	.3833	.3	.25	.2333	.2833

Table 2: Grand-Fair Split Trend

Over time, the grand-fair proposal is less observed in the Majority treatment, while it does not fade out in the Unanimity treatment. This grand-fair split tendency does not affect the average claim.

More than 50% of the proposals allocate the (almost) entire costs to one member in the Majority treatment. Observing this in the previous period does not lead to decreased claims. Risk aversion doesn't seem to play.

Takeaway Messages, so far

- Public bads production is hard to deter.
- Theoretically and experimentally, unanimity doesn't help to reduce public bads. ("If you produce that much, why wouldn't I, who has the same veto power, produce that much?")
- A "threat" to allocate the entire costs to one member whose environmental harm was the largest doesn't help to reduce public bads. ("If everyone fully produces public bads, it all boils down to a lottery. Why would I reduce production?")
- An increase in α from 0.8 to 1.2 reduces public bads production to some degree in both voting rules.

Upcoming

An increase in α from 0.8 to 1.2 reduces public bads production to some degree in both voting rules.

- Is it because of social preferences or the fear of being punished?
- New treatments, U16 and M16, can answer it. If the average claims in both U16 and M16 decrease similarly, it might be due to social preferences. If public bads production in M16 is deterred significantly more than other treatments, then the "punishment" works.