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?

- How would a voting rule affect?
- How would a size of negative impact to the society affect?

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 $C = \alpha \sum_i g_i$, $\alpha \in (0, 2)$.
- 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 $g_i - \frac{C}{2}$.

  (* Why $C/2$? Simple representation of $\delta > 1$)
- $q = 2$: majority. $q = 3$: unanimity.

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

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 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 $\alpha < 2$.

Equilibrium When $q = 2$

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

- We focus on two "extreme" ones.

  (extreme in the sense that 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 assigns the entire costs to **one person** 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 assigns the entire costs to **one person** 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.

Interim Summary

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
- Allocating the entire costs to the largest contributor.
- 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 $\alpha > \frac{3}{2}$, public bads production may decrease.
- When $q = 2$ and $\alpha \in (1, \frac{3}{2})$, observing $p = (0, 0, 1)$ in the previous bargaining round will decrease g_i.

Experimental Design

Treatment	Voting Rule (q)	Cost Multiplier(α)	#Sessions
U08	Unanimity (3)	0.8	2
M08	Majority (2)	0.8	2
U12	Unanimity (3)	1.2	3
M12	Majority (2)	1.2	3
U16	Unanimity (3)	1.6	3
M16	Majority (3)	1.6	3

- The subjects are anonymously divided into groups of three.
- Each person can claim up to 200 tokens.
- 1st stage: Claim $g_i \in [0, 200]$. $C = \alpha \sum g_i$ is later known.
- 2nd stage: Submit a proposal. When q or more members vote for the one randomly selected proposal, the costs are distributed accordingly. If not, $C/2$ is charged to all.
- Repeat this for 5 periods. Random rematch

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)
M16 (last 2 periods)	146.54 (147.97)	703.35 (710.21)
U16 (last 2 periods)	147.56 (166.53)	708.27 (799.33)

Table 1: Average claims and public bads

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

Results, so far

Grand-fair split ($=1$ if max(costs)$-$ min(costs)≤ 10) gets less observed in M; does not fade out in U.

Treatment\Period	1	2	3	4	5
Majority	0.104	0.083	0.042	0.031	0.021
Unanimity	0.271	0.219	0.177	0.177	0.229

Table 2: Grand-Fair Split Trend

Most-unequal split ($=1$ if costs$\geq$ 90% of the entire costs) gets more observed in M.

Treatment\Period	1	2	3	4	5
Majority	0.240	0.365	0.510	0.594	0.781

Table 3: Most-Unequal Split Trend

Virtuous circle of the fear being punished?

- One theoretical argument relies on the undercutting competition for being unpunished.
- Undercutting claims in order not to be punished is valid **only when** proposers punishes the largest claimer.
- We frequently observe the most-unequal proposals, rejecting the ideas about risk aversion and Rawlsian social welfare.
- But this most-unequal proposal is not clearly translated as a "punishment," because
  - when all claim 200, allocating the entire cost to one person;
  - when the proposer claims the most, allocating the entire cost to the second-largest contributor

  does not seem to be the punishment to the most contributor.

Takeaway Messages, so far

- Public bads production is (very) hard to deter.
- Theoretically and experimentally, unanimity doesn't help to reduce public bads. ("If you mess up that much, why wouldn't I, who has the same veto power, do 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 reduces public bads production to some degree in both voting rules. Although proposals differ by voting rule, the rule per se does not help reducing public bads.