Optimal altruism in public good provision

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Social preferences now play important role in economic analysis

This paper: **Social preferences in public good provision**

1. Welfare impact of unselfish behaviour
   - Players altruistically-minded yet rational
   - Tension between altruism & crowding-out effects
2. Preferences & incentives $\Longrightarrow$ "**Optimal altruism**"
3. Range of applications—focus on global climate policy

Recent climate policy initiatives

Recent **unilateral climate initiatives** at local, national & regional levels

- EU to reduce GHG emissions by 20% until 2020
- UK aims to cut carbon emissions by 80% by 2050
- Australia & New Zealand, US (California, RGGI), China, others

Increasing **use of social cost of carbon** in regulatory decision-making

- Several EU countries (Netherlands, Finland, Italy, UK) apply SCC
- US has developed measure of SCC & applied to selected regulations

No binding global agreement to jointly reduce carbon emissions

- Many countries unwilling to go beyond "business-as-usual"

Climate change policy & international altruism

Evidence that for some unilateral policies, **domestic benefits** $<$ **costs**

- **European Union's "20/20/2020" package**
  CBA suggests (benefits/costs) < 1 for range of scenarios
- **United Kingdom's 2008 Climate Change Act**
  Impact Assessment: "Benefits of UK action will be distributed across the globe"...."Economic case for the UK continuing to act alone where global action cannot be achieved would be weak" (DECC)

Difficult to reconcile such policies with central tenet of self-interest...

$\Longrightarrow$ **Role for "unselfish" objectives** that go beyond national welfare

This paper: *How is altruism optimally reflected in abatement policies?*

Results from the analysis

Three main results:

1. More altruistic behaviour by a player often *reduces* social welfare
2. *Almost* always optimal to act more selfishly than true preference
3. Optimal altruism often *"low"*—even when strongly altruistic

$\Longrightarrow$ Difficult to infer social preferences from observed behaviour

Overview of the talk

- Benchmark model & key properties
- Welfare impact of small altruistic commitments
- Optimal altruistic commitments
- Robustness of the main results
- Implications for climate policy

Setup of the benchmark model

Two players i and j contribute to a public good ($k = i, j$)

- **National welfare** $\Pi_k = B_k(X_i + X_j) - C_k(X_k)$
  - Standard assumptions $B_k' > 0, B_k'' < 0$ and $C_k' > 0, C_k'' > 0$
- **Global welfare** $W = \Pi_i + \Pi_j$

Modelling players' degrees of altruism:

- **True objective** $S_k = (1 - \theta_k)\Pi_k + \theta_k W$
  - $\theta_k \in [0, 1]$ is true preference for altruism
- **Strategic objective** $\Omega_k = (1 - \lambda_k)\Pi_k + \lambda_k S_k$
  - $\lambda_k \in [0, 1]$ reflects strategic preference

$\Longrightarrow$ Welfare impact of altruistic behaviour & optimal altruism $\lambda_k^*(\theta_i, \theta_j)$

Key properties of the model

Interpretation: Delegation of policy decisions

Model timing:

1. Countries endowed with $B_k(\cdot), C_k(\cdot)$, and true altruism θ_k $(k = i, j)$
2. Citizens choose commitment λ_k to maximize true objective S_k
3. Politicians choose contribution X_k to maximize strategic objective Ω_k

$\Longrightarrow$ Subgame-perfect Nash equilibrium $\Longrightarrow X_k^*(\lambda_i, \lambda_j)$ at Date 3

Key properties:

1. Stronger commitment increases contribution, $dX_i^* / d\lambda_i > 0$
2. Higher contribution leads to "leakage", $L_i \equiv (-dX_j^* / dX_i) \in (0, 1)$
   - Players' efforts are *strategic substitutes*

Other applications of the model

- Environmental policy
- Problems of the commons
- Defense spending
- Economics of the family
- Corporate joint ventures

Welfare impact of small altruistic commitments

Proposition

The impact of a small unilateral commitment $d\lambda_i$ by player i on her equilibrium true objective satisfies

$$\left.\frac{dS_i^*}{d\lambda_i}\right|_{\lambda_i=\lambda_j=0} = \left[\left(\theta_i B_j' - B_i' L_i\right)\frac{dX_i^*}{d\lambda_i}\right]_{\lambda_i=\lambda_j=0}$$

Commitment $\Longrightarrow dX_i^* > 0$ but $\Longrightarrow dX_j^* < 0$ (crowding-out)

- **Two direct effects** on own net benefits are zero (envelope theorem)
- **Two strategic effects** are positive and negative:
  1. Player j gains from free-riding by $B_j' dX_i^* > 0$ (weight $\theta_i \in [0,1]$)
  2. Player i loses from leakage by $B_i' dX_j^* = -B_i' L_i dX_i^* < 0$ (full weight)

Also ambiguous impact on *global* welfare, $dW^*/d\lambda_i \gtrless 0$ (just set $\theta_i = 1$)

$\Longrightarrow$ *May not be good idea to go ahead with a commitment...*

Generalized impact of unilateral commitment

- **Generalized impact** of unilateral commitment by player i:

$$dS_i^* = \underbrace{\left[\begin{array}{c}\text{direct effect}\\ \text{on player } i\ (\leq 0)\end{array} + \begin{array}{c}\text{strategic effect}\\ \text{on player } i\ (<0)\end{array}\right]}_{=d\Pi_i^*<0} + \begin{array}{c}\text{true altruism}\\ \text{of player } i\ (\theta_i \in [0,1])\end{array} \times \underbrace{\left[\begin{array}{c}\text{direct effect}\\ \text{on player } j\ (\geq 0)\end{array} + \begin{array}{c}\text{strategic effect}\\ \text{on player } j\ (>0)\end{array}\right]}_{=d\Pi_j^*>0}.$$

$\Longrightarrow$ Equilibrium impact & sign$\left(\frac{dS_i^*}{d\lambda_i}\right)$ depend on relative magnitudes

A full commitment is almost never optimal

Proposition

Players' optimal commitments $\lambda_i^* = 1$ *and* $\lambda_j^* = 1$ *if and only if their true preferences are entirely altruistic,* $\theta_i = \theta_j = 1$

First-best efforts $\Longleftrightarrow$ *both* players entirely unselfish

- No incentive to unilaterally deviate from bilateral full commitment

Example: If $\theta_i = 1$ but $\theta_j < 1$, then $\lambda_i^* < 1$ (and also $\lambda_j^* < 1$)
$\Longrightarrow$ Delegate to politicians with preferences closer to national self-interest

- *Player who genuinely cares about global welfare does best by being at least somewhat selfish*. Why?
  1. Small decrease in own effort $\Longrightarrow$ 2^{nd} order loss in global welfare
  2. Induced rise in other's effort $\Longrightarrow$ 1^{st} order gain ("**Reverse leakage**")

A zero/low commitment is often best

Proposition

(a) If the ratio of marginal benefits B_i'/B_j' is sufficiently large (and $\theta_i < 1$ or $\theta_j < 1$), then player i's optimal commitment $\lambda_i^* = 0$;
(b) If θ_i and θ_j are positive but sufficiently small, then $\lambda_i^* = \lambda_j^* = 0$.

Part (a) $\Longrightarrow$ Policy of full commitment (e.g., global social cost of carbon) may be welfare-dominated by zero commitment

- Let $(\theta_i, \theta_j) = (1, 0)$. For B_i'/B_j' sufficiently large, global welfare W^* higher with $(\lambda_i, \lambda_j) = (0, 0)$ than $(\lambda_i, \lambda_j) = (\ell, 0)$ for *any* $\ell \leq 1$

Part (b) = For "sufficiently small" altruism, positive free-riding effect swamped by leakage $\Longrightarrow$ Both players do best by acting entirely selfishly

- Let $B_i(\cdot) = B_j(\cdot)$ and $\theta_k < L_k$ $(k = i, j)$. Then $(\lambda_i^*, \lambda_j^*) = (0, 0)$

Optimal interior commitments

Proposition

In an interior equilibrium with $(\lambda_i^*, \lambda_j^*) \in (0,1)^2$,

$$\lambda_i^* = \frac{\left[\theta_i(1 - L_i L_j) - (1 - \theta_i\theta_j)\left(B_i' / B_j'\right)L_i\right]}{\theta_i\left(1 - \theta_i\theta_j L_i L_j\right)} \in (0,1),$$

where equilibrium rates of leakage

$$L_i = \frac{\left[1 + \lambda_j^*\theta_j(B_i'' / B_j'')\right]}{\left[1 + (C_j'' / |B_j''|) + \lambda_j^*\theta_j(B_i'' / B_j'')\right]} \in (0,1),$$

and player i's equilibrium effort satisfies $X_i^* = C_i'^{-1}\left(B_i' + \lambda_i^*\theta_i B_j'\right) > 0.$

- **Informational requirement**: B_i' / B_j' & B_i'' / B_j'', $C_k'' / |B_k''|$ & θ_k

Inferring players' levels of altruism

Suppose it is observed/estimated that i's effort is selfish ($\lambda_i^* \theta_i = 0$)

- Does *not* follow that true preference $\theta_i = 0$ since maybe $\lambda_i^* = 0$
  - Statement "No unilateral climate action $\Longrightarrow$ being selfish" easily false

Proposition

(a) For $0 < \theta_i = \theta_j < 1$, *optimal commitments may satisfy* $\lambda_i^* \theta_i \neq \lambda_j^* \theta_j$;
(b) For $0 < \theta_j < \theta_i$, *optimal commitments may satisfy* $\lambda_j^* \theta_j > \lambda_i^* \theta_i$;
(c) If $0 < \theta_j < \theta_i$, *optimal commitments in interior equilibrium satisfy* $(\lambda_i^* \theta_i - \lambda_j^* \theta_j) < (\theta_i - \theta_j)$ *if* $B_i' \geq B_j'$ *&* $L_i \geq L_j$.

$\Longrightarrow$ *Caution required in inferring altruism from observed behaviour & making cross-country comparisons*

Robustness of the main results (I)

Specification of strategic objective

- Main results robust to functional form of Ω_k

Definition of "global welfare"

- Could instead let $W = S_i + S_j$ *directly* feature altruism

Pure vs impure public goods

- Benefits could depend on players' *weighted* efforts

Robustness of the main results (II)

Generalization to $n \geq 3$ players ("one bad apple")

- Contributions made in "aggregative game" $\Longrightarrow$ Player-specific leakage rates $L_{ij} \equiv \left[-dX_j / dX_i\right] > 0$
  $\Longrightarrow$ Overall leakage rate $L_i \equiv \left[-\sum_{j \neq i} dX_j / dX_i\right] \in (0, 1)$

Cross-country cost spillovers ("two-edged sword")

- More abatement reduces other country's costs (learning-curve effects; technology spillovers) $\Longrightarrow$ Let $C_i(X_i, X_j)$ such that $L_i \in (0, 1)$

Other altruistic objectives ("warm glow")

- Let true objective function $S_i = \Pi_i + \widehat{\theta}_i \Phi_i$ where $\widehat{\theta}_i \in [0, 1]$
  - $\Phi_i(X_i, X_j)$ is altruistic (overstates benefits; understates costs)
  - "Warm glow" with $\Phi_i(\cdot) = g_i(X_i)$

Impact of altruism on carbon leakage

How does altruistic behaviour affect leakage rates?

Proposition

(a) If $B_j''' \leq 0$ *and* $C_j''' \leq 0$, *leakage satisfies* $L_i|_{\lambda_j^*>0} > L_i|_{\lambda_j^*=0}$

(b) If $B_j''' = 0$, $C_j''' = 0$, B_i''/B_j'' *constant, leakage satisfies* $\partial L_i/\partial \lambda_j > 0$

- Unselfish component of j's effort choice has 100% leakage rate: $\partial \Pi_i/\partial X_j = B_i'(X_i + X_j)$ constant $\iff dX_j = -dX_i$
  - High rates of carbon leakage *because* countries are altruistic!

$\Longrightarrow$ *Altruistic behaviour often worsens free-riding problem at the margin*

Strategic properties of policy commitments

Proposition

(a) Suppose that B_i'/B_j' is constant. Player i's optimal commitment varies with player j's commitment according to

$$sign\left\{\frac{d\lambda_i^*}{d\lambda_j}\right\} = sign\left\{\frac{1}{\eta_{ij}} - \left(\frac{1-\lambda_j^*\theta_i\theta_j}{\lambda_j^*\theta_i\theta_j}\right)\right\}$$

where $\eta_{ij} \equiv \left[(dL_i/L_i)/(d\lambda_j/\lambda_j)\right]_{\lambda_k=\lambda_k^*}$.
(b) Suppose that B_i'/B_j', B_j''/C_j'' and B_i''/B_j'' are all constant. Then $\eta_{ij} \in (0,1)$, and so $d\lambda_i^*/d\lambda_j > 0$ if $\lambda_j^*\theta_i\theta_j \geq \frac{1}{2}$ while $d\lambda_i^*/d\lambda_j < 0$ if $\lambda_j^*\theta_i\theta_j$ is sufficiently small.

- **Strategic substitutes** if $\eta_i > 0$ and $\lambda_j\theta_i\theta_j$ ("joint altruism") small
- **Strategic complements** if $\eta_i \leq 0$ *or* $\lambda_j\theta_i\theta_j$ large

$\Longrightarrow$ *Strategic properties of commitments differ from contributions*

Implications for climate policy

Social preferences can explain any outcome $\in$ [self-interest, first-best]

$\Longrightarrow$ Recent unilateral policy *might* be driven by altruistic preferences

Equilibrium analysis yields sharper conclusions:

1. Suboptimal for any subset of countries to unilaterally employ SCC
   - Limited project use of SCC broadly consistent with our results
2. Sometimes little or no action by altruistically-minded players
3. Caution required in trying to infer countries' degrees of altruism

Other issues & directions for future research

Optimal altruism in public good provision

- Altruistic-yet-rational players account for incentive effects
  - Leakage $\Longrightarrow$ Optimal altruism $<$ true preference

What could lead to more favourable outcomes?

1. Moving towards a more *cooperative setup*
   - Unilateral climate policy "in the shadow" of cooperative talks
2. Public good problems with *negative leakage*
   - Relatively little theoretical/empirical backing...
3. Players making *conditional commitments*
   - Committing to do more if others also do more