Lecture 6: Optimal taxes & sub-sidies - efficiency and distributition

- Purpose
  - Understand weighting in welfare assessments
  - Show how to implement optimal taxes in a welfare economic framework
  - Understand differences first and second best implementation

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Outline

- General welfare economic theory framework
  - welfare weighting (implications of welfare priorities)
  - what does the regulator know, and what does he not know = truthtelling in policy
  - steps in the maximization proces (from the full info "act as God" (First Best) to settings with less info. (Second Best))
- A simple model of providing public goods
  - demonstrates First - Second Best demarcation
  - First: regulator knows what is needed to implement
  - Second: what is achievable with current info.

General framework

- From principal-agent/RAM approach

Principal: $\max_{\{var\}} SWF(a_i)$

s.t.(1): agents $\max_{\{\mathbf{x}_i,\mathbf{z}_i\}} V_i(\mathbf{p},M_i;z_i)\ \forall\ i \in I$ [agents' behav]

s.t.(2): set of policy constraints (or new price vector, **p**, if policy is a price constraint [incentive comp. constr]

s.t.(3): $V_i(\mathbf{p},M_i;z_i) \geq V_{io}$ [part.constraint]

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... general framework (2)

- The (Samuelson-Bergson) social welfare function (SWF)

Principal: $\max_{\{\mathbf{t,q,a}\}} SWF(a_i) = \max_{\{\mathbf{t,q,a}\}} \Sigma_i \beta_i \hat{V}_i(\mathbf{p},M_i,z)$

t: vector of taxes
q: vector of quantity restrictions
a: vector of actions (command and control)

β_i : the weight regulator assigns group i in society
$\hat{V}_i$: the regulator's assessment of the indirect utility function of group *i* in society

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... general framework (3)

- Comments on the SWF / principal's view:
  - instruments (**t,q,a**) may not enter SWF, but are contained in the agents' policy environment
  - regulator does not know each group's indirect utility function ⇒ regulator uses best assessment of this function:

$$\hat{V}_i(\mathbf{p}, M_i, z)$$

    - ➡ source of criticism of the Samuelson-Bergson SWF framework
  - the distributional weights β_i politically decided
  - welfare: only for citizens (consumers) who own shares in firms ⇒ changes in firm profits on welfare captured through money income, M_i

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... general framework (4)

Bergson-Samuelson social welfare function:

$$\text{Principal: } \max_{\{\mathbf{t,q,a}\}} \ \text{SWF}(a_i) = \max_{\{\mathbf{t,q,a}\}} \ \Sigma_i \beta_i \hat{V}_i(\mathbf{p}, M_i, z)$$

- More on welfare weighting
  - equal weighting: β_i is one (or $1/N$)
  - politically motivated weighting: groups that are prioritized are given a larger relative weight
    - ➡ poor people / race / indogenous people / gender
    - ➡ extreme weighting: others than the target group(s) receive weight $\beta_i = 0$

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Asymmetric information (1)

- Regulators only know agent preferences with uncertainty = estimates of preferences :: $\hat{V}(.)$
- Agents maximize their **actual** utility (here - represented by indirect utility function) :

agent i max $V_i(\mathbf{p},M_i;z_i)$
$\{\mathbf{x}_i,\mathbf{z}_i,\mathbf{a}_i\}$

s.t.(1): set of policy constraints (or new price vector, **p**, if policy is a price constraint [incentive comp. constr]) - may be in firm's profit function which may be reflected in agents' welfare through changes in money income, M_i

s.t.(2): $V_i(\mathbf{p},M_i;z_i) \geq V_{io}$ [part.constraint group i]

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... asymmetric information (2)

- Comments on the difference the principal's (regulator's) and the agents' view:
  - regulator's expectations: $\hat{V}_i(\mathbf{p},M_i,z)$
  - agents' actual utility fnc.: $V_i(\mathbf{p},M_i,z)$ (which is the individual agent's private info.)

Remark: goes to the core of RAMs: what instruments to choose under various assumptions on the regulator's ability and costs of observing agent type and behavior

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... asymmetric information (3)

- Steps in the way to solve the generic social welfare maximization problem

1. Assume full information ("act as God") and solve the maximizatio problem using the relevant choice variables (that may not be observable)
   - Gives the First-Best solution that we later try to replicate / use as a bench-mark
2. Solve the generic maximization problem using the policy variables (taxes, subsidies, quantity restr.) the regulator can use under various information scenarios
   - May replicate the First-Best (lucky) OR
   - Give another solution that is close (Second-Best)

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Implementation issues (1)

- Under asymmetric info, implementation of
  - first best (FB) OR
  - second best (SB)

  hinges on the regulator's possibilities/capabilities of inducing truthful revelation

- Two cases:
  - full truthful revelation ⇒ FB is implemented
  - partial truthful revelation
    ⇒ FB not implemented
    ⇒ some SB is implemented, but with lower SW

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... implementation issues (2)

From theory - Bergson-Samuelson social welfare function:

Principal: $\max_{\{\mathbf{t,q,a}\}}$ SWF(a_i) = $\max_{\{\mathbf{t,q,a}\}} \Sigma_i \beta_i V_i(\mathbf{p}, M_i, z)$

- In "real life" (applications) the SWF formulation SWF(a_i) = max $\Sigma_i \beta_i V_i(\mathbf{p}, M_i, z)$ (often) replaced by

- Project perspective - max net benefits of regulation (policy vector **d** : $NB(\mathbf{d}) = B(\mathbf{d}) - C(\mathbf{d})$)
  - example: tax for emissions reductions: $NB(t) = B(t) - C(t)$ s.t. $\Sigma_i \ MC_i(q_i) = MC(q) = t$
  - $B(t)$ = int $D(q(t))$, $C(t)$ = int $MC(q(t))$

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Example - max.project benefits (1)

- Advice: work in emissions reductions space (then supply and demand "comes out right")

- Let
  - $MC(q) = q \Rightarrow TC(q) = q^2/2 = C(q(t))$
  - $D(q) = 12 - q$
    $\Rightarrow B(q) = 12\, q - q^2/2$

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.. example - max.project benefits (2)

- First best (full info. secenario)
  - emissions fully observable by the regulator
- Finding optimal tax ⇒ solve: $D(q) = MC(q)$
  $12 - q = q \Rightarrow 2q = 12 \Rightarrow q^* = 6$
  tax that implements $q^* = 6$ :: t^* (= q^*) = 6
- Total benefits ($q^* = 6$)
  $= B(q^*) - C(q^*) = B(6) - C(6)$
  $= 12q - 1/2\, q^2 - 1/2\, q^2$
  $= 12 \times 6 - 1/2 \times 6^2 - 1/2 \times 6^2 = 36$

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... example - max.project benefits (3)

- In 2nd best (limited information), assume regulator observes 50% of emissions (reductions)
  ⇒ can only tax 50% ⇒ $MC'(q) = q/2$
- Finding optimal tax ⇒ solve: $D(q) = MC'(q)$
  $12 - q = q/2 \Rightarrow 3/2\, q = 12 \Rightarrow q^* = 8$
  tax that implements $q' = 8$ :: t' (= q') = 8
- Total benefits ($q' = 8/2$)
  $= B(q^*) - C(q^*) = B(4) - C(4)$
  $= 12q - 1/2\, q^2 - 1/2\, q^2$
  $= 12 \times 4 - 1/2 \times 4^2 - 1/2 \times 4^2 = 32$

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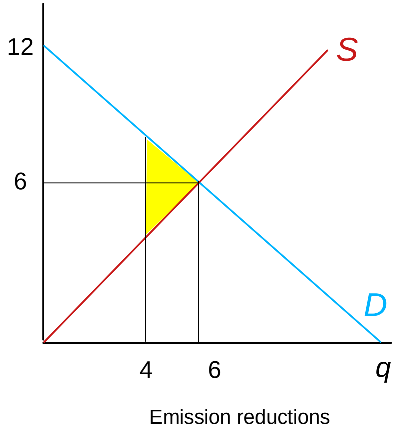
... example - max.project benefits (3)

- Higher tax needed (from 6 to 8) but with reduced abatement
- Net benefits drop from 1st to 2nd best:
  - full info. (1st best) $q_{FB} = 6$, $NB_{FB} = 36$
  - limited info. (2nd best) $q_{SB} = 4$, $NB_{SB} = 32$
  - welfare loss apr. 12 %



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Summary

- Maximizing social welfare
  - the social welfare function (differences between regulator's perception of agents' utility fncs, and agents' actual utility fncs)
  - the distributional weights (βs)
  - availability of policy instruments
  - all affect the optimal and attainable outcomes
- Steps in the solution process (slide 9)
  - find the First-Best "acting as God"
  - try to replicate the First Best with policy variables the regulator has at his disposal (First Best not attainable ⇒ Second Best)

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